CATALOGUE No. 126.

Hoisting Engines

AND

ACCESSORIES

Allis-Chalmers Co.

MILWAUKEE, WIS.

U. S. A.

Hoisting Engines

AND

ACCESSORIES

Drum Hoisting Engines,
Reel Hoisting Engines,
Whiting System Hoisting Engines,
Fleeting Engines, Indicators,
Hoisting Hooks, Cages,
Cage Chairs, Skips, Buckets, Cars,
Sheave Wheels, Landing Dogs.

Allis-Chalmers Company

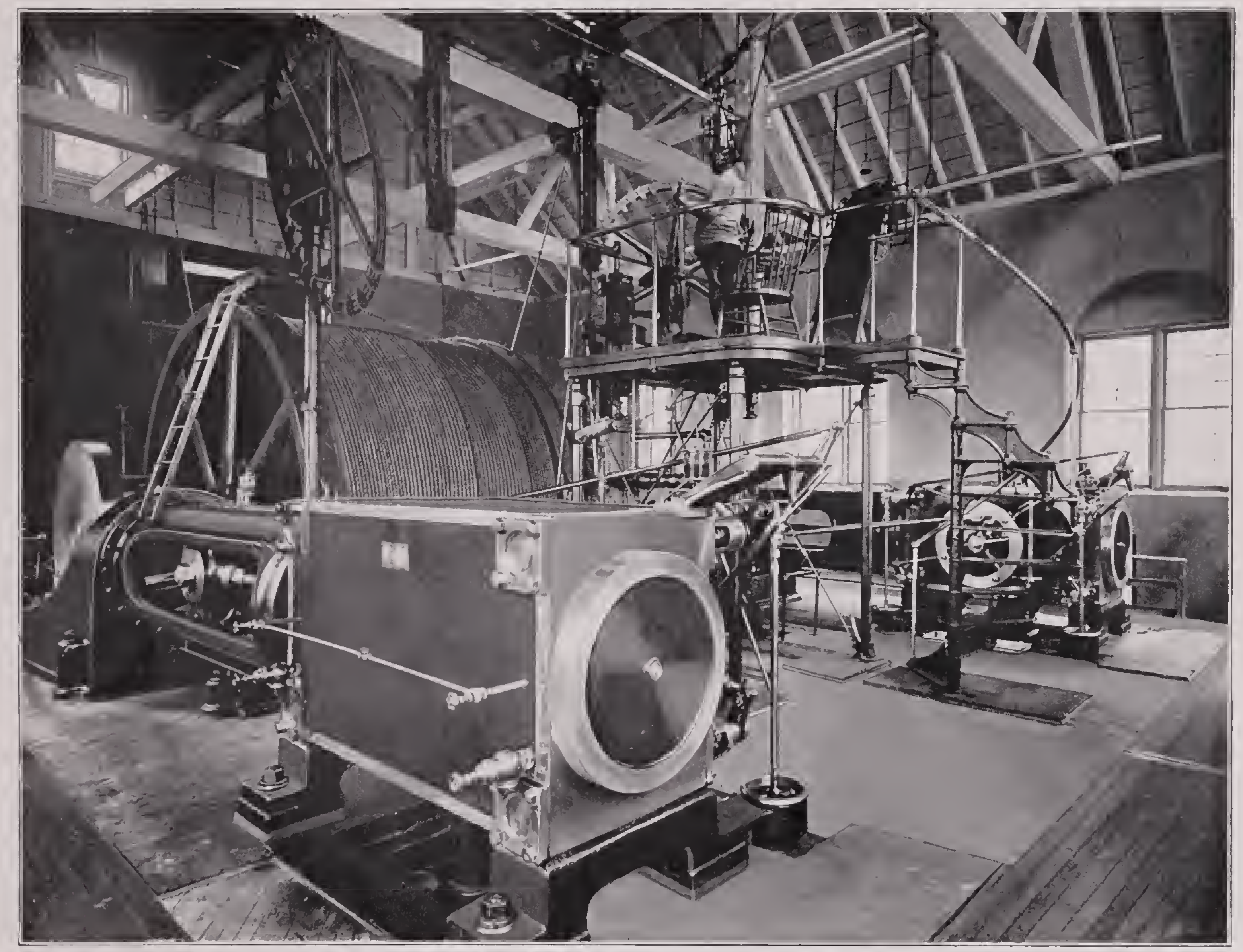
Milwaukee, Wisconsin

U. S. A.

Catalogue No. 126.

INDEX.

Plate No. 2096.



Hoist at Wolverine Mine, Shaft No. 3, Calumet, Mich.

Hoisting Engines.

GREETING.

Allis-Chalmers Company feels that it needs no introduction to the great mining world.

The accumulated experience of more than four decades of successful practice in designing and building mining machinery to be operated under an almost infinite variety of conditions has caused this Company's name to be favorably known in every part of the globe where mining operations are carried on.

We assure the mining fraternity that we are deeply gratified by their evident appreciation of our efforts in the interest of progress and quality of product.

As our reputation is built upon this foundation there will be no diminution of our efforts to always maintain for our products the foremost place with those whose business success depends upon their employing the most modern appliances and practice which have been proven to be absolutely reliable and commercially correct.

COMPLETE HOISTING EQUIPMENTS—We are now devoting especial attention to the designing and building of complete hoisting equipments for metal and coal mines.

We solicit enquiries upon this subject.

We are prepared to furnish complete hoisting equipments for any service or tonnage. These will comprise not only the latest and most economical winding plants operated by either steam, electricity, water or air as local conditions may make desirable, but also single and multi-decked cages, self-dumping skips for vertical or inclined shafts, timber skips of the latest design, bailing tanks, shaft chairs, cars, buckets, safety detaching hooks, sheave wheels, pneumatically operated ore gates for loading skips from the shaft pockets according to the latest practice, and everything necessary for the safe and most economical handling of the broken material from the mine to the shipping bins, mill or breaker, as well as all accessory appliances.

EXPERIENCED ENGINEERS—We have a corps of experienced engineers skilled in hoisting work whose services are at your disposal for advise upon all hoisting questions.

Our prices are as low as is consistent with the employment of the proper material and workmanship in the production of the machinery to absolutely safeguard the lives of men and the property handled by the hoists.

HOISTS ERECTED AND TRIED IN THE SHOPS—Every hoist we build is completely assembled and *turned over* in our erecting shop before it leaves the works.

Each part when fitted to its proper place is marked with a steel stamp so that no difficulty may occur when the machine is installed at the mine.

If desired we will furnish competent men to superintend the erection work.

DATA REQUIRED TO MAKE ESTIMATES—In estimating on a hoisting equipment for your requirements it is necessary for us to have the following data:

1—The number of tons of ore or coal to be hoisted in a given time.

2—The weight and capacity of the cage, skips or tubs if these are already on the ground.

3—(a) The maximum depth of the shaft from which it is desired to hoist. (b) If not a vertical shaft, the length of the incline or slope and its greatest inclination from the horizontal or its grade in percentage.

4—If possible send a rough sketch showing the size of the shaft compartments in the clear, the size and position of the guide timbers and the center-to-center distances of the compartments.

5—Give the steam pressure to be employed; or if you intend using electricity advise us as to the voltage, phase and frequency of the current.

6—How much time during each 24 hours will be available for hoisting mine products after deducting the time required for handling men and timbers.

7—Will the hoisting be "balanced" or "unbalanced"?

8—Do you prefer any particular system of hoisting?

9—Please advise us as to transportation facilities, as such information is often an important factor to be considered in designing a plant.

10—The capacities given in this catalogue under the head of "Maximum Gross Load" refer to the greatest total load under which the engines will start *with the cranks in any position.*

"LOAD."

EXPLANATION OF THE TERM AS IT IS USED IN CONNECTION WITH RAISING ORE FROM MINES.

In hoisting engine transactions it is absolutely necessary that the exact meaning of the word "load" should be understood by both parties.

In order to avoid confusion we call the amount of ore raised the "net load," and the weight of ore, car, cage and rope the "total load." The last item, "rope," is very frequently overlooked in correspondence about hoisting engines. In the case of flat rope hoisting from deep mines, the weight of the rope is usually greater than the remainder of the total load. Considering this, it can be appreciated that the weight of the rope has great influence in determining the size of a hoisting engine.

Where hoisting is done with the weight of certain parts of the total load counterbalancing the weight of others, hoisting is said to be "in balance." The remaining weight is "unbalanced load," and is that which the engine must lift, but the strength of the various parts, such as clutches, shaft, etc., must be proportioned to stand the total load. Hence, it is not sufficient to state the amount of the unbalanced load only.

PORTABLE HOISTS.

Our Portable Hoists are built with single or double drums. They are unsurpassed in compactness, durability and simplicity of construction. The engines of double cylinder hoists are connected by a cast iron bed plate to which they are firmly bolted, making a solid and rigid base requiring no special foundation.

All unnecessary finish has been done away with and we have put its cost into substantial workmanship and material.

The drums fitted with our band friction clutch are loose on their shafts. The drum hubs are lined with removable brass bushings, the clutch and brake being of sufficient strength to easily hold the maximum load. Shafts, rods and pins are made of high grade steel and not, as is so frequently the case, of inferior material.

All operating levers are conveniently arranged. Cylinders are neatly lagged with sheet iron. All parts are accessible and provided with ample means for lubrication.

Illustrations of these hoists will be found in the following pages.

SINGLE DRUM HOISTING ENGINES, WITH SHAFTS DESIGNED TO RECEIVE A SECOND DRUM.

Single Drum Hoisting Engines may be designed so as to permit an additional drum to be fitted on the shaft at some future time.

This arrangement involves but comparatively little extra expense and permits the capacity of the hoist to be augmented to keep pace (within certain limits) with the development of the mine, thus saving to the mine owners the possible expense of purchasing a second hoist of greater capacity.

A hoisting engine of the character above referred to was built by us for the Elkhorn Mining Company. This hoist is of the double cylinder, single drum, direct acting type. Size of cylinders 20 in. by 60 in., size of drum 9 ft. by 3 ft. 6 in. The post brake, jaw clutch and link motion reversing gear are steam operated. The hoist is also fitted with crank brakes, indicator, etc. This hoisting engine was in operation for many years as a single drum hoist, but lately was fitted with the second drum and the necessary operating mechanism for the same, in this manner more than doubling the capacity of the hoist at a small outlay.

We build hoisting engines to be operated either by steam, compressed air, electricity, or water power, and also so designed that where several of the forces mentioned are available for use either may be employed in turn at the will of the operator.

A hoist of the last mentioned type was recently built by us for the Tomboy Gold Mines Company, Limited, and is to be driven by compressed air or electricity.

A hoist built by us for the Darien Gold Mining Company can be driven by steam or by water.

Our extended and varied experience in designing and building standard and special hoisting engines places us in a position to assure the customer that the power available will be utilized in the most economical and efficient manner.

We value correspondence relating to these subjects and shall be pleased to give customers our best advice and judgment.

HOISTS USING ROUND ROPE.

SINGLE DRUM HOISTING ENGINES.

STANDARD SINGLE DRUM PORTABLE HOISTING ENGINE.

Our standard single drum portable hoist is shown in Plate 577.

The hoist is built in three types as follows:

WITH BAND FRICTION CLUTCH AND BAND BRAKE.

This hoist has no reversing gear, and consequently has only two hand levers, as shown by Plate 577. The friction clutch permits of the load being lowered under brake control.

On page 12 will be found a table of sizes in which this type of hoist is built.

WITH BAND FRICTION CLUTCH, BAND BRAKE AND LINK MOTION REVERSING GEAR.

This hoist is similar in all respects to the one previously described, except that it is provided, in addition, with a reversing gear. With this hoist, the load may be lowered under steam as well as under brake control, the advantage of the former method being an increase of safety when lowering men.

On page 12 will be found a table of the sizes in which this style of hoist is built.

WITH DRUM KEYED TO SHAFT, BAND BRAKE AND LINK MOTION REVERSING GEAR.

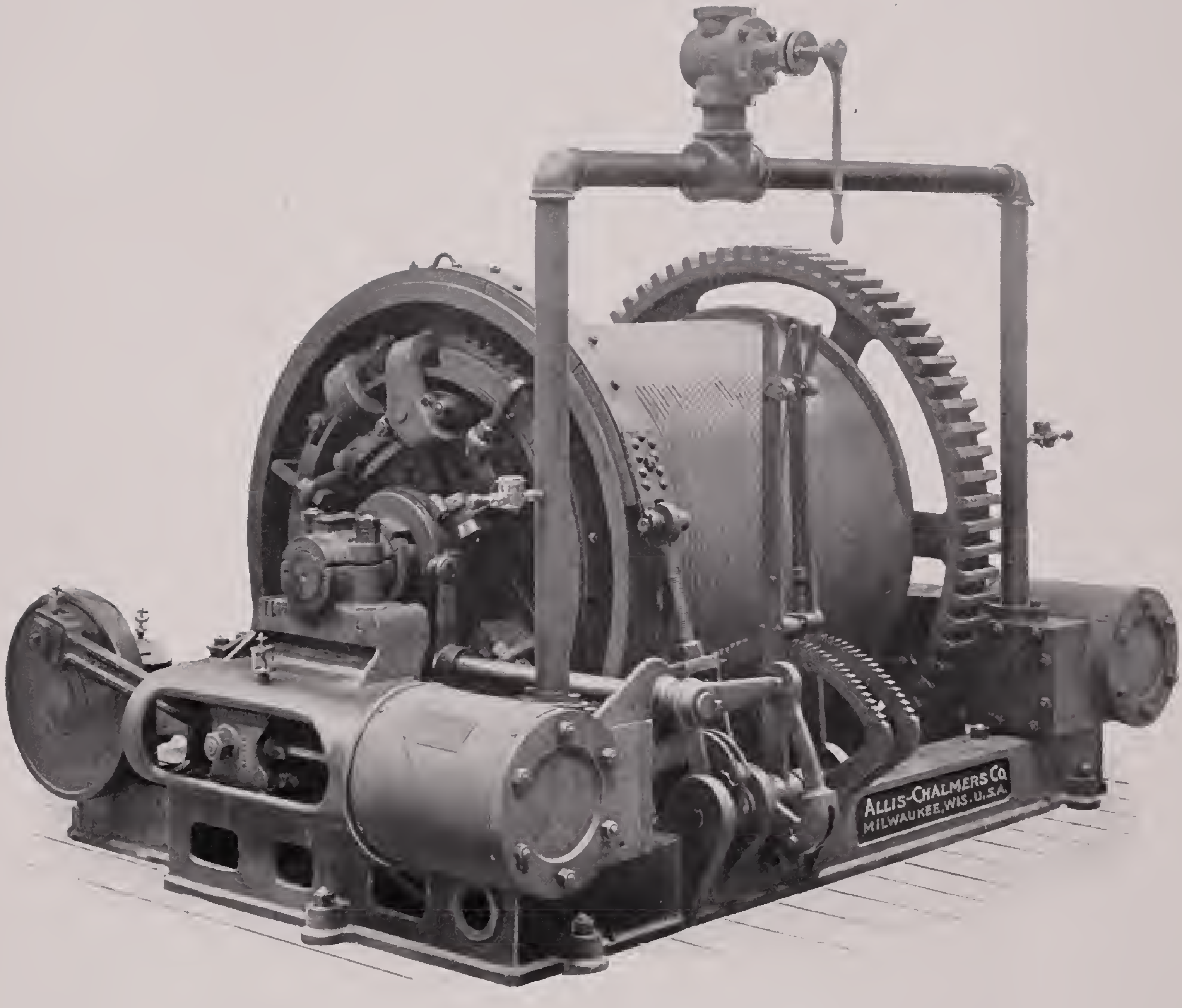
In this hoist the drum is keyed to the shaft, placing it under direct control of the steam. The construction is simpler than that of the two preceding types and the weight is less, this resulting in a hoist of less cost.

On page 12 will be found a table of sizes in which this type of hoist is built.

FOR MOUNTAIN TRANSPORTATION.

These hoists may be made sectional (300-lb. limit) to facilitate transportation in mountainous regions. The weight of the heaviest piece is 350 lbs.

Plate No. 577.



Single Drum Portable Hoisting Engine.

STANDARD DOUBLE CYLINDER SINGLE DRUM PORTABLE HOISTING ENGINE

With Band Friction Clutch and Band Brake

Standard Drums are Grooved for the Sizes of Rope Specified Below   Steam Pressure, 80 Lbs. per Sq. Inch.

Code Word	No.	Cylinder		Size of Drum		Dia. Rope	Feet Rope in One Coil	R.P.M of engines	Ratio of Gears	Hoist Speed, Ft. per Min.	Max. Gross Load	Diameter Steam Pipe	Dia. Exhaust Pipe	Finished Weight
		Dia.	Stroke	Dia.	Leng.									
		in.	in.	in.	in.	in.					lbs.	in.	in.	lbs.
Agnize...	0	6	8	24	18	⅝	164	260	4. to 1	400	2,000	1½	2	3,800
Agnocasto...	1	7	10	32	24	¾	247	250	5.53 to 1	376	2,800	2	2½	6,000
Agnomen.....	2	8	10	32	36	¾	375	240	5.53 to 1	360	3,650	2½	3	7,500
Agnominate	3	9	12	42	40	¾	540	235	5.53 to 1	462	4,250	2½	3	11,000
Agnoscebas.	4	10	12	42	48	¾	650	225	5.53 to 1	440	5,250	2½	3	12,000
Agnoscens...	5	10	15	48	40	⅞	500	218	6. to 1	450	6,350	3	3½	18,000
Agnostic.....	6	12	15	48	48	⅞	600	190	5.06 to 1	471	7,200	3	3½	19,500
Agobiaba....	7	12	18	54	48	⅞	670	180	5.06 to 1	500	8,250	3½	4½	28,000
Agobiamos..	8	14	18	60	48	1	670	150	5.06 to 1	471	9,900	3½	4½	30,200

With Band Friction Clutch, Band Brake and Link Motion Reversing Gear

Standard Drums are Grooved for the Sizes of Rope Specified Below   Steam Pressure, 80 Lbs. per Sq. Inch.

Code Word	No.	Cylinder		Size Drum		Dia. Rope	Feet Rope in One Coil	R.P.M. of Engine	Ratio of Gears	Hoist Speed Ft. per Min.	Max. Gross Load	Diameter Steam Pipe	Diameter Exhaust Pipe	Finished Weight
		Dia.	Stroke	Dia.	Leng.									
		in.	in.	in.	in.	in.					lbs.	in.	in.	lbs.
Agnellinum..	0A	6	8	24	18	⅝	164	260	4. to 1	400	2,000	1½	2	4,000
Agnellorum.	1A	7	10	32	24	¾	247	250	5.53 to 1	376	2,800	2	2½	7,200
Agnellos......	2A	8	10	32	36	¾	375	240	5.53 to 1	360	3,650	2½	3	7,900
Agnellotto...	3A	9	12	42	40	¾	540	235	5.53 to 1	462	4,250	2½	3	11,500
Agnelons.....	4A	10	12	42	48	¾	650	225	5.53 to 1	440	5,250	2½	3	12,500
Agnels.........	5A	10	15	48	40	⅞	500	218	6 to 1	450	6,350	3	3½	17,900
Agnette.......	6A	12	15	48	48	⅞	600	190	5.06 to 1	471	7,200	3	3½	19,600
Agnicao.......	7A	12	18	54	48	⅞	670	180	5.06 to 1	500	8,250	3½	4½	28,800
Agnicelli......	8A	14	18	60	48	1	670	150	5.06 to 1	471	9,900	3½	4½	31,000

With Drum Keyed to Shaft, Band Brake, and Link Motion Reversing Gear

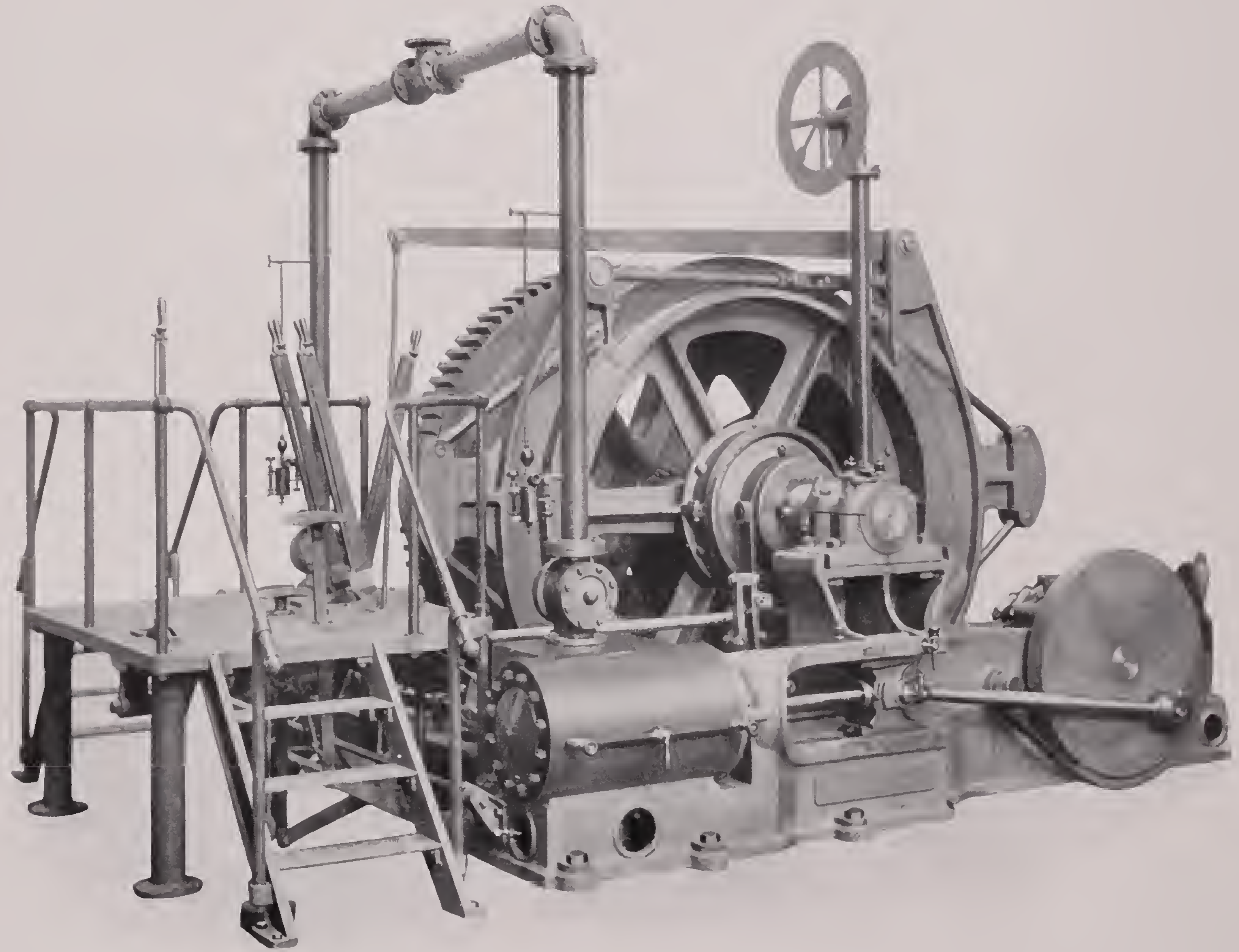
Standard Drums are Grooved for the Sizes of Rope Specified below.   Steam Pressure 80 lbs. per Sq. Inch.

Code Word	No.	Cylinder		Size Drum		Diam. Rope	Feet Rope in One Coil	R.P.M. of Engine	Ratio of Gears	Hoist Speed, Ft. per Min.	Max. Gross Load	Diameter Steam Pipe	Diameter Exhaust Pipe	Finished Weight
		Diam.	Stroke	Diam.	Length									
		in.	in.	in.	in.	in.					lbs.	in.	in.	lbs.
Agnilibus.....	0B	6	8	24	18	⅝	164	260	4. to 1	400	2,000	1½	2	3,700
Agnilis.........	1B	7	10	32	24	¾	247	250	5.53 to 1	376	2,800	2	2½	6,800
Agninos.......	2B	8	10	32	36	¾	375	240	5.53 to 1	360	3,650	2½	3	7,400
Agninum.....	3B	9	12	42	40	¾	540	235	5.53 to 1	462	4,250	2½	3	10,800
Agnistiche...	4B	10	12	42	48	¾	650	225	5.53 to 1	440	5,250	2½	3	11,800
Agnistico.....	5B	10	15	48	40	⅞	500	218	6. to 1	450	6,350	3	3½	17,700
Agnitorem...	6B	12	15	48	48	⅞	600	190	5.06 to 1	471	7,200	3	3¼	19,200
Agnitoris.....	7B	12	18	54	48	⅞	670	180	5.06 to 1	500	8,250	3½	4½	27,600
Agniturae....	8B	14	18	60	48	1	670	150	5.06 to 1	471	9,900	3½	4½	29,800

SINGLE DRUM GEARED HOISTING ENGINE.

Plate 746 illustrates a compact design of geared hoisting engine intended to be used more especially for continuous and heavy hoisting in the regular operation of a mine but not as a sinking or prospecting hoist. The hoist shown has duplex plain slide valve engines, and a 7-foot drum grooved for round rope. The Drum is loose on the shaft and fitted with bronze bushings. It is driven from the shaft by means of a jaw clutch. In order to facilitate clutching in, the disc cranks on the engine are fitted with a band brake operated by a foot-step on the engineer's platform so as to render it unnecessary to handle the heavy post brakes every time the clutch is shifted. The main brake is of the post pattern with a large wearing surface on the brake wheel to reduce to a minimum the trouble from heating and wear of wooden brake shoes. The operations of this hoist are controlled by hand levers and foot-steps so arranged that the engineer can handle the hoist without moving from his place. Each steam cylinder has a separate rotary throttle valve close to the clinder. Engines so fitted respond more quickly than do those where a single valve is used.

Plate No. 746.



Single Drum Geared Hoisting Engine.—For Heavy Duty.

From a photograph of an engine built for the Congress Gold Company of Arizona. Gross capacity, 9,500 lbs. hoisted at 650 ft. per minute. Cylinders, 14 inches diameter, 24-inch stroke. Drum 7 ft. diameter. Dial Indicator positively driven to show position of the cage in the shaft.

SINGLE DRUM, DOUBLE ROPE HOIST.

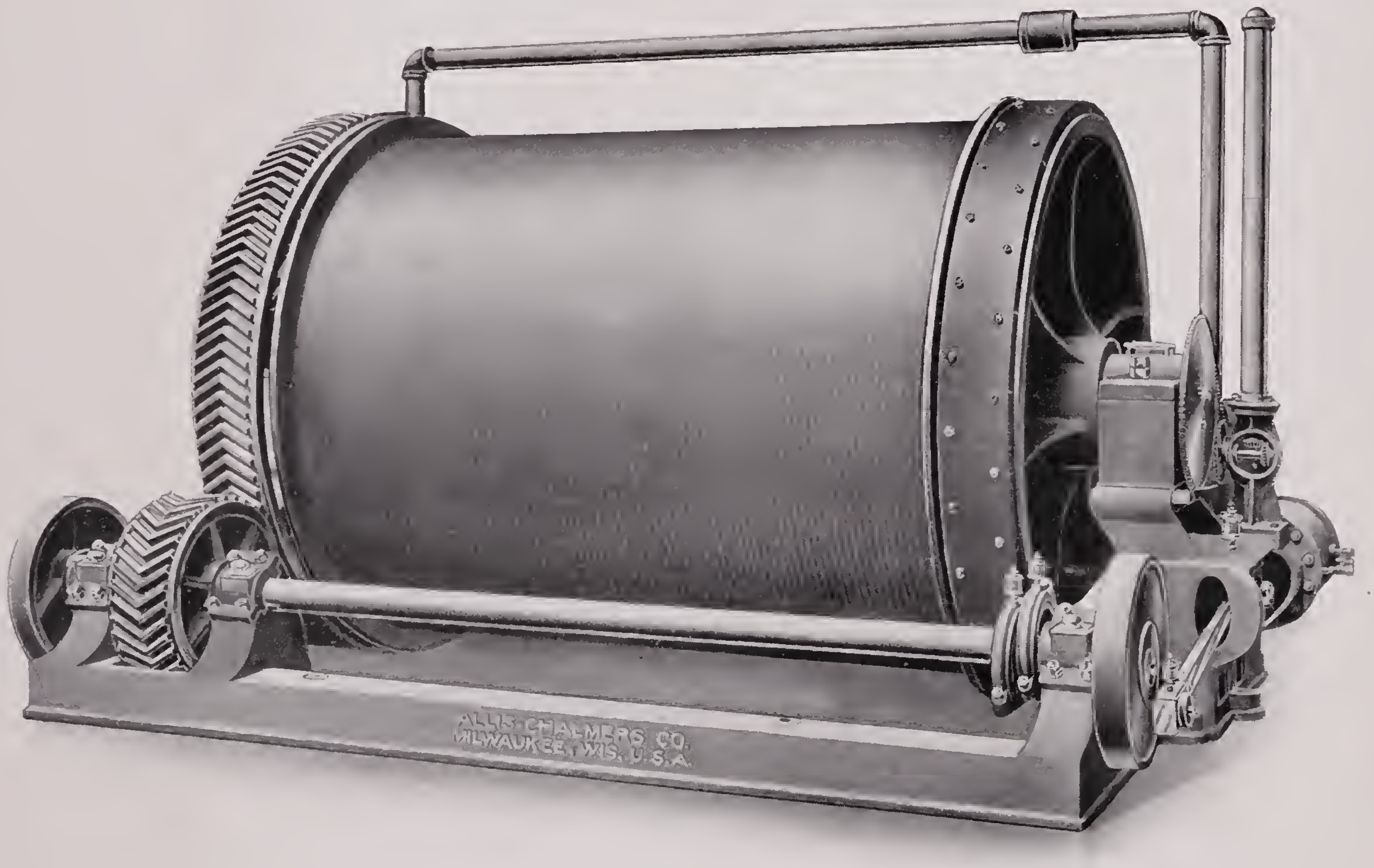
Plate 1058 illustrates a Single Drum Hoisting Engine, built for the Mohawk Mining Co. The cylinders are 14 in. by 18 in. and a link motion reversing gear permits hoisting with two ropes, one leading from the upper and the other from the lower side of the drum. The drum is keyed to the shaft and is 84 inches in diameter and 104 inches face. It was made of this length to allow for winding the two ropes on it, one from each end and in opposite directions. With this arrangement hoisting can be done from two shafts with the cages in balance and hoisting from the same level.

The capacity of this hoist is 15000 lbs., gross load, hoisted at the rate of 1000 feet per minute from a depth of 1500 feet, the shaft being at an incline of 41 degrees. One end of the drum may be provided with a suitable take-up to adjust the length of rope in use and thus readily provide for changing to other levels from which material may be hoisted.

We have built six of these engines and they continue to be very popular.

For balanced hoisting on a large scale, see Whiting type of hoisting engine herein described.

Plate No. 1058.



Single Drum Geared Hoisting Engine.—For High Speed.

DIRECT ACTING SINGLE DRUM HOISTING ENGINE.

Plate 747 shows a Direct Acting, Single Drum Hoisting Engine, built by us for the Peñoles Mine.

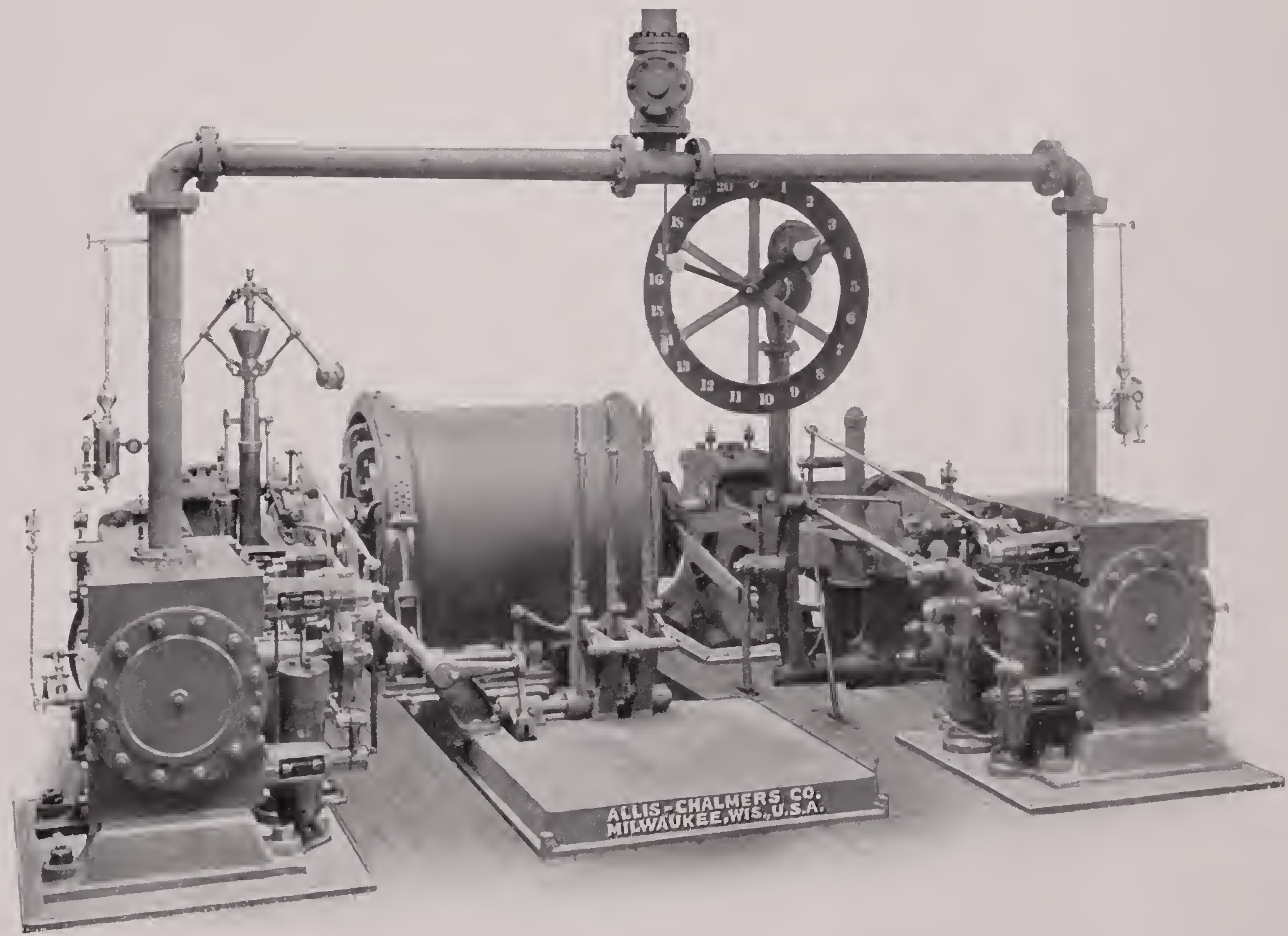
This hoist is driven by Duplex 12¼ in. by 24 in. Corliss Engines and is fitted with a standard band friction clutch, band brake and link motion reversing gear.

All operations of the hoist are controlled by hand levers which are conveniently grouped on the engineer's platform.

The dial indicator, it will be noticed, has two hands, one hand making a complete revolution in the entire length of the lift, while the other one makes a complete revolution in the last 100 feet of the lift, thus indicating more positively the position of the skip or cage, and enabling the engineer to prevent overwinding.

The capacity of the engine is 3500 pounds, hoisted at a speed of 1000 feet per minute from a depth of 1800 feet.

Plate No. 747.



Direct Acting Single Drum Hoisting Engine.

DOUBLE DRUM HOISTING ENGINES.

STANDARD DOUBLE CYLINDER, DOUBLE DRUM, PORTABLE HOISTING ENGINE,

With

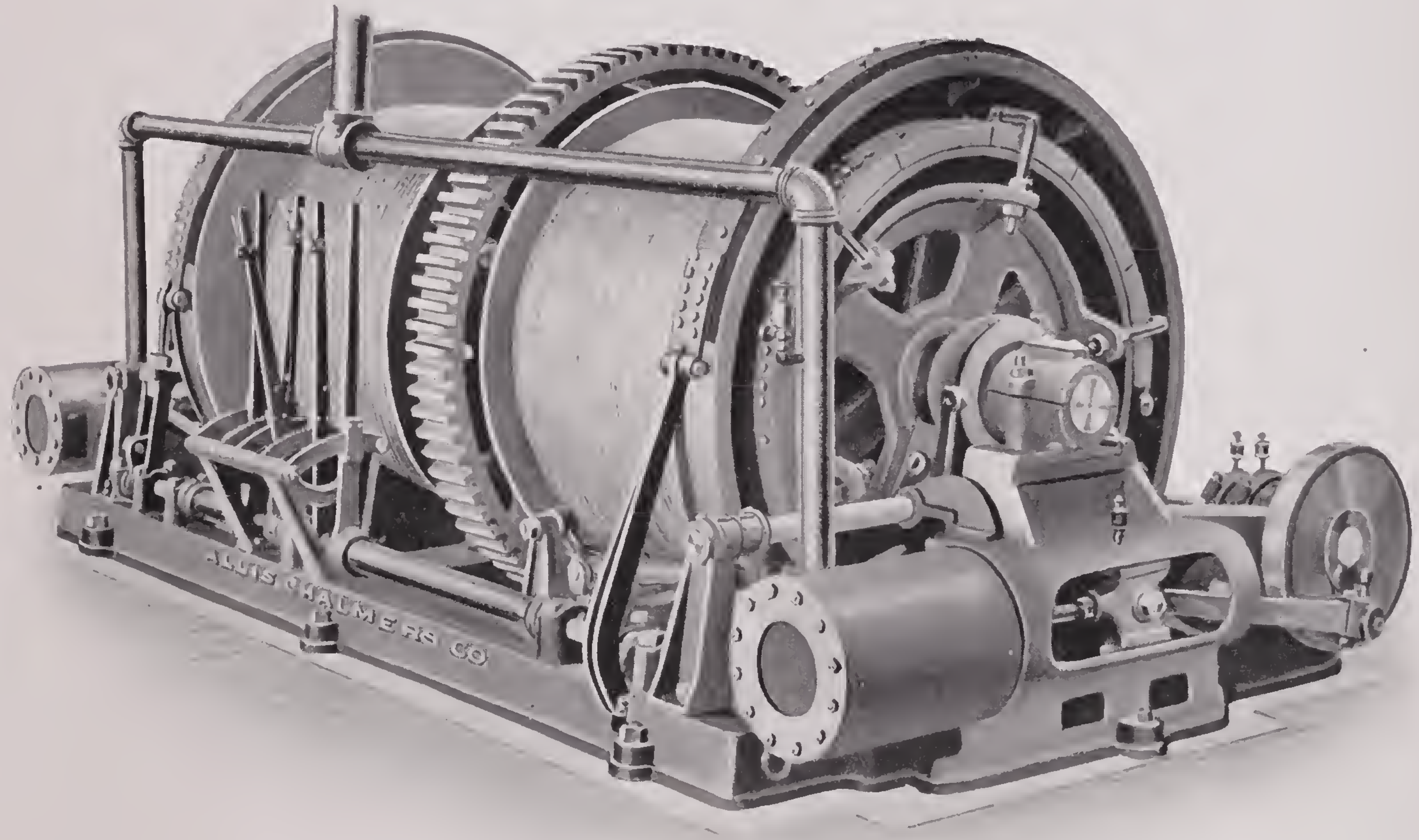
Band Friction Clutches, Band Brakes and Link Motion Reversing Gear.

Plates 1062 and 1063 represent our Double Cylinder, Double Drum Hoisting Engine, with Band Friction Clutches, Band Brakes and Link Motion Reversing Gear. This hoist is designed for a double compartment shaft.

Both drums are loose on the shaft and each is provided with an independent band friction clutch for driving it, permitting the hoisting to be performed balanced or unbalanced as may be required. Where the hoist will always run in balance, and from the same level, the clutches may be omitted, and the drums keyed to the shaft.

The hoisting engine represented by the illustrations was built for the American Mining Company. Its cylinders are 14 in. by 18 in. and it has a capacity of 200 tons per 24 hours from a depth of 1600 feet. The drums are independent and the engine is reversible.

Plate No. 1062.



Double Drum Geared Portable Hoisting Engine.—Cylinder End.

The American Mining Company after two years' operation of this hoist ordered a duplicate which speaks well for the satisfactory working of the first engine.

These engines are built with post brakes instead of band brakes if desired and may also be supplied with *cut steel gears* and *raw hide pinions.*

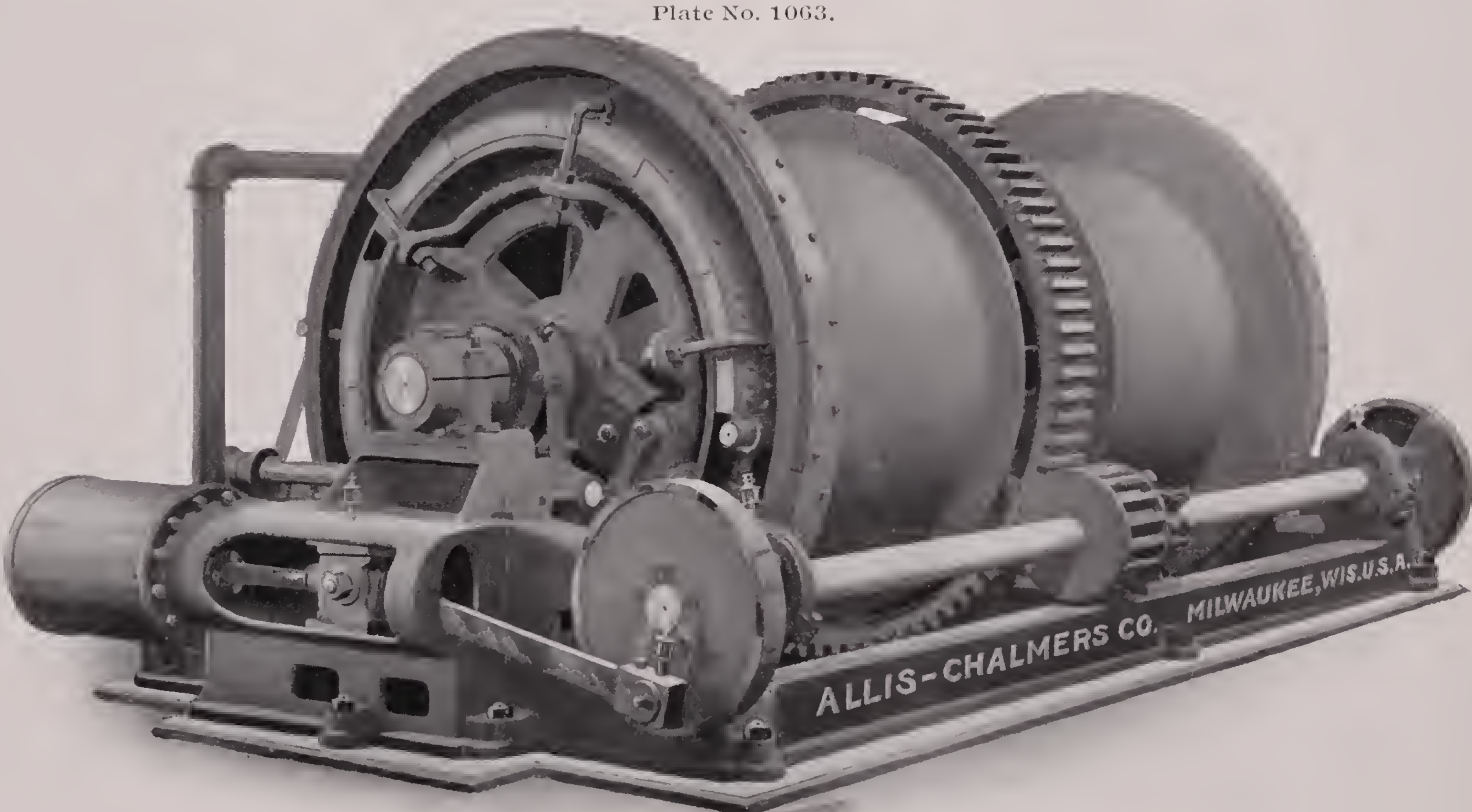
STANDARD DOUBLE CYLINDER DOUBLE DRUM PORTABLE HOISTING ENGINE

With Friction Band Clutches, Band Brakes, and Link Motion Reversing Gear

Standard Drums are Grooved for the Sizes of Rope Specified below. Steam Pressure 80 lbs. per Sq. Inch. Cut-off at ¾ Stroke.

Code Word	No.	Cylinders		Drums		Diam. Rope	Feet Rope in One Coil	R.P.M. of Engine	Ratio of Gears	Hoist Speed. Ft. Per Min.	Max. Gross Load	Diameter Steam Pipe	Diameter Exhaust Pipe	Finished Weight
		Diam.	Stroke	Diam.	Length									
		in.	in.	in.	in.	in.					lbs.	in.	in.	lbs.
Aglutinaba..	50	9	12	42	24	¾	330	235	5.53 to 1	462	4,250	2½	3	18,200
Aglutinado..	51	10	12	42	36	¾	485	225	5.53 to 1	440	5,250	2½	3	21,300
Aglutinais...	52	10	15	48	40	⅞	500	218	6. to 1	450	6,350	3	3½	29,500
Aglutinare...	53	12	15	48	48	⅞	600	190	5.06 to 1	471	7,200	3	3½	32,500
Aglutino......	54	12	18	54	48	⅞	670	180	5.06 to 1	500	8,250	3½	4½	45,000
Agminal......	55	14	18	60	48	1	670	150	5.06 to 1	471	9,900	3½	4½	47,000

Plate No. 1063.



Double Drum Geared Portable Hoisting Engine.—Crank End.

SECTIONALIZED DOUBLE-CYLINDER, DOUBLE-DRUM HOIST.

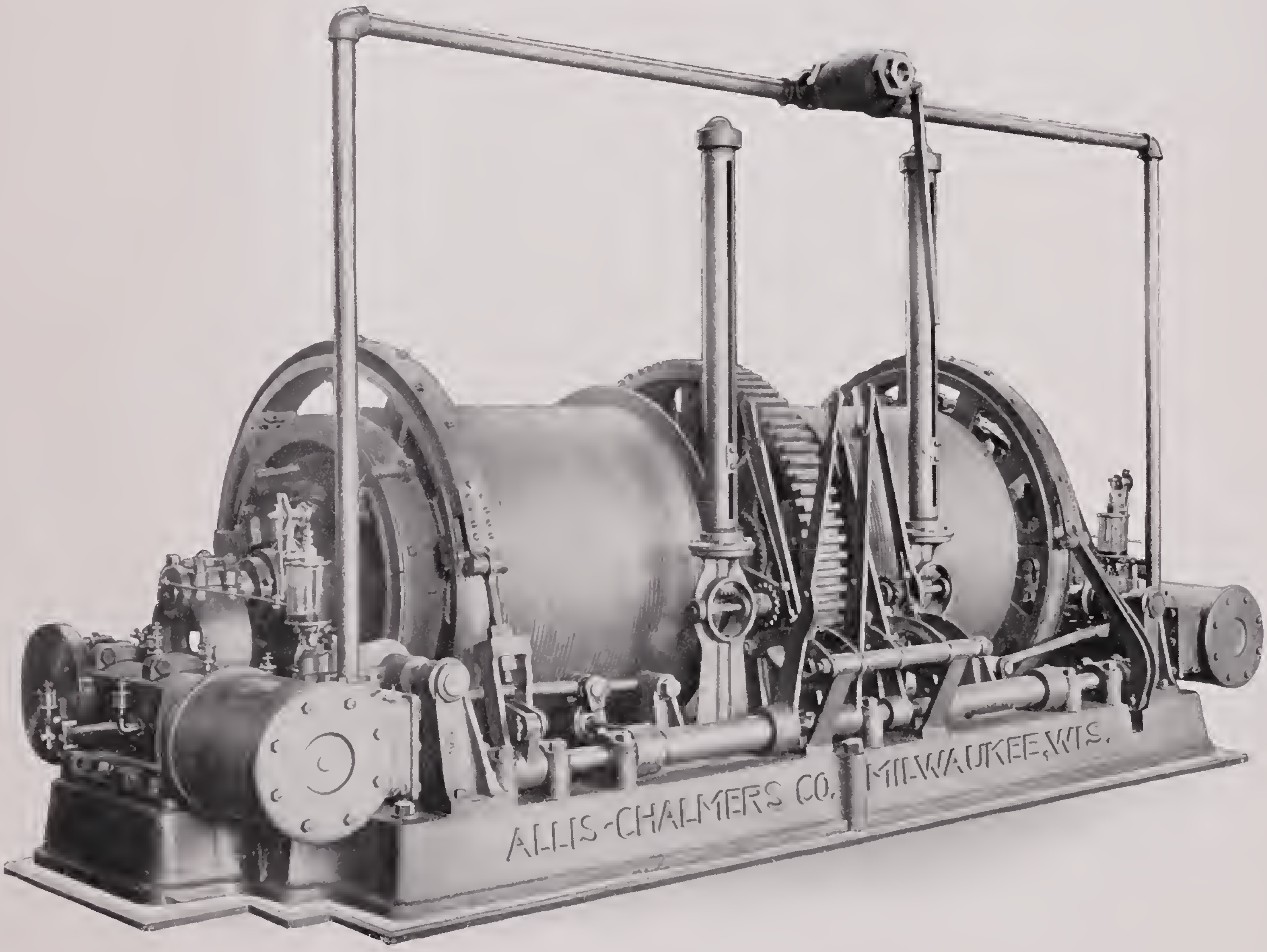
Plate 1050 shows a Double Drum Hoisting Engine sectionalized to a 300-pound limit, for mule-back transportation. This hoist is driven by a duplex slide valve engine with cylinders 8 in. diameter by 12 in. stroke, and is fitted with drums 42 in. diameter by 36 in. face. The drums are driven from the shaft by means of our standard band friction clutches and each drum is fitted with a band brake. The engine has link motion reversing gear and column indicators show the position of the cage in the shaft. This hoisting engine has a capacity of 3600 lbs. gross load hoisted at a speed of 460 ft. per minute from a depth of 600 ft. Compressed air is often used to operate the hoist.

The cut shows how neatly the sectionalizing has been accomplished, as notwithstanding the fact that the bed plate is made in many pieces the joints are practically invisible.

The hoist was built by us for the Darien Gold Mining Company.

We make a specialty of machinery sectionalized so as to facilitate transportation in regions difficult of access.

Plate No. 1050.



Double Drum, Geared Hoisting Engine.—Sectionalized to 300 Lb. Limit.

SPECIAL DOUBLE DRUM, GEARED HOISTING ENGINES.

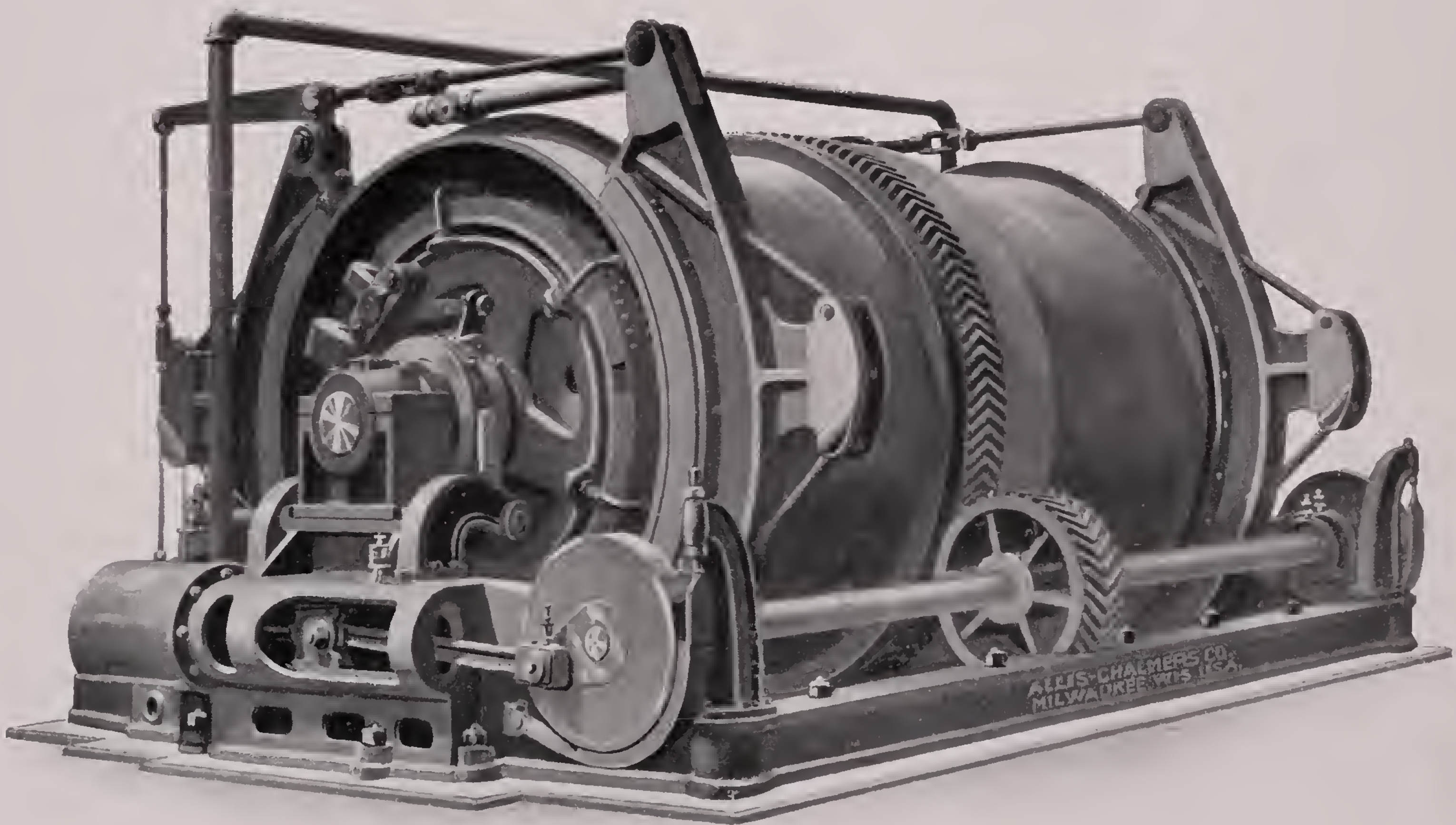
The Double Drum Geared Hoisting Engines shown below and on pages 20 and 21 were furnished by us to the Alaska United Gold Mining Company. They are of special design for heavy and rapid hoisting. The drums are driven by band friction clutches and are fitted with post brakes. The brakes and clutches are applied by hand wheels, while the brakes on the crank discs are applied by a foot lever. The link motion reversing gear is operated by a hand lever.

Plate 1052 shows the 12 in. by 16 in. Hoisting Engine, and Plate 913 shows the 15 in. by 24 in. Hoisting Engine. Plate 1051 is described in detail on page 21.

On page 20 is given a table of sizes, capacities, etc., for these three hoisting engines. If the standard sizes do not meet the requirements, we will be pleased, upon application, to quote upon special hoisting engines.

Since the above named hoists were delivered we have received an additional order from the same company for a duplicate hoisting engine. Concerning the efficiency of our hoists, the manager of the mine writes as follows: "These hoisting engines are the best designed engines for this work I am acquainted with."

Plate No. 1052.



Special Double Drum Geared Hoisting Engine.

ALLIS-CHALMERS

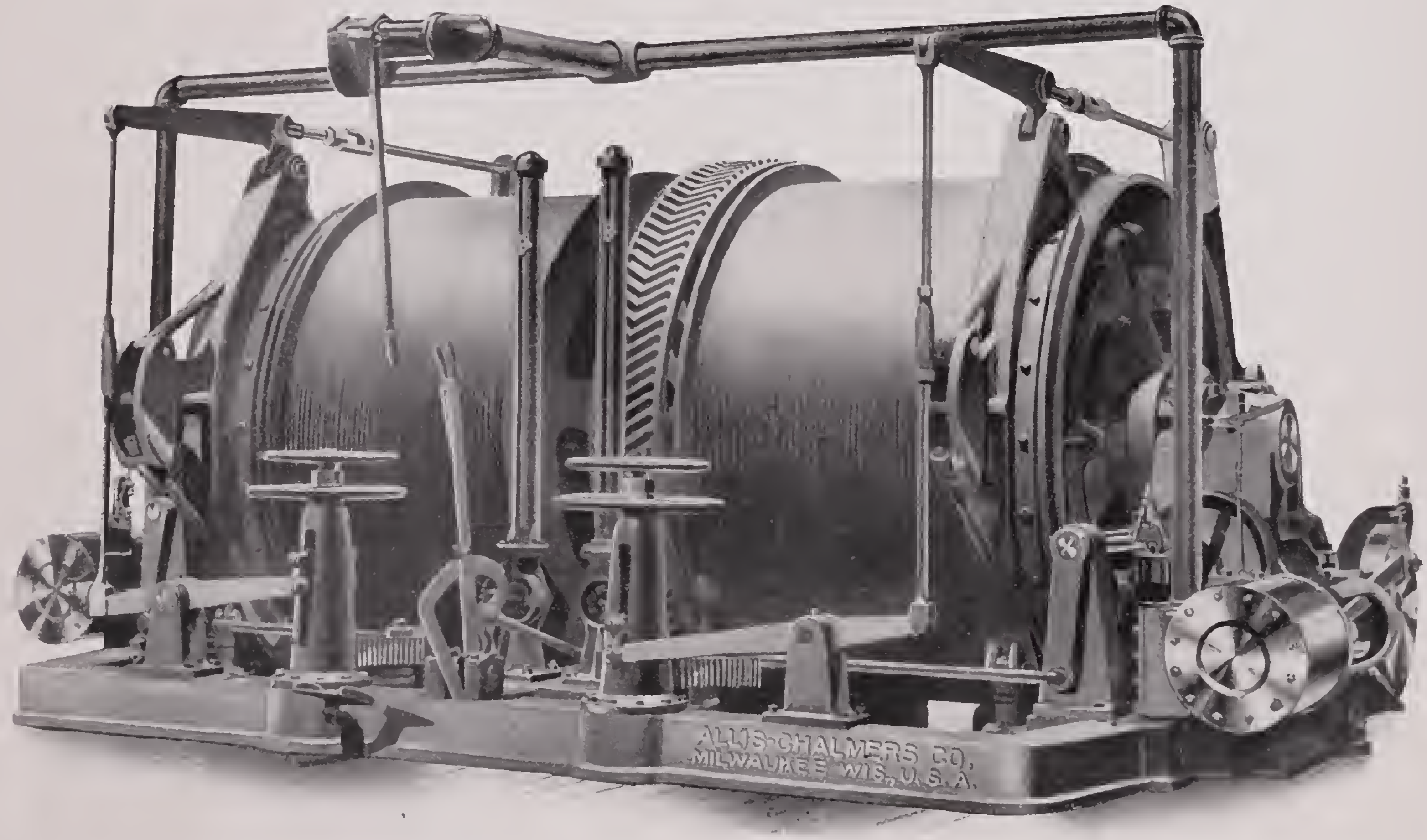
SPECIAL DOUBLE CYLINDER, DOUBLE DRUM, GEARED HOISTING ENGINES

With Band Friction Clutches, Post Brakes and Link Motion Reversing Gear

Steam Pressure 110 lbs. per Sq. Inch.

Code Word	Cylinders		Drums		Diam. Rope	Feet Rope in One Coil	R.P.M. of Engine	Ratio of Gear	Hoist Speed Ft. Per Min.	Max. Gross Load	Diameter Steam Pipe	Diameter Exhaust Pipe	Finished Weight
	Diam.	Stroke	Diam.	Length									
	in.	in.	in.	in.	in.					lbs.	in.	in.	lbs.
Agnituros....	12	16	84	48	1	1000	150	3.32 to 1	1000	4,700	3	3½	70,000
Agniturun...	14	18	84	48	1	1000	150		1000	7,200	3½	4½	71,200
Agnodemus	15	24	84	58	1⅛	1000	150		1000	11,000	4	5	90,000

Plate No. 913.

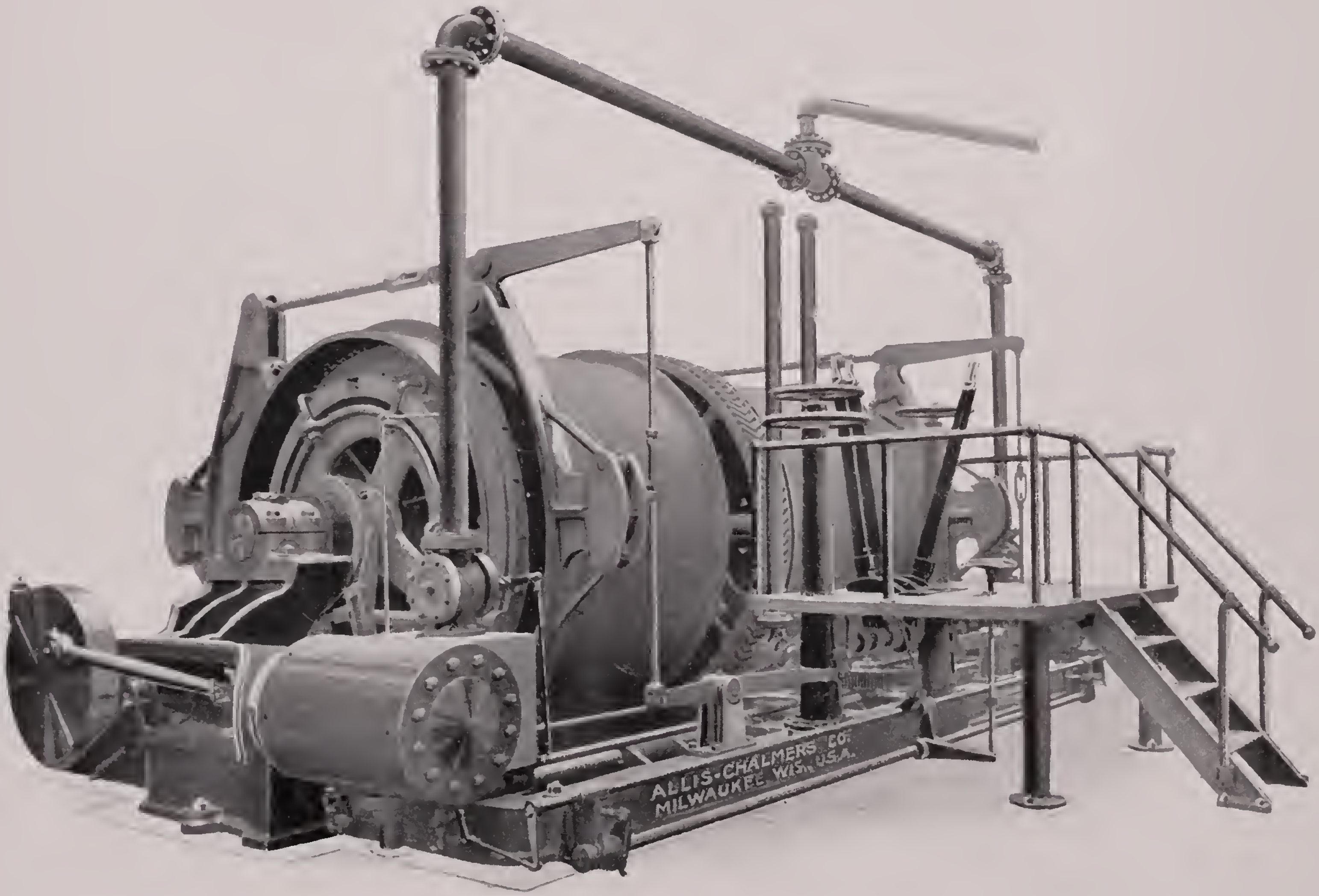


Special, Double Drum, Geared Hoisting Engine.

DOUBLE DRUM, GEARED HOISTING ENGINE.

Plate 1051, shown below, represents a Double Drum, Geared Hoisting Engine, built for the Alaska United Gold Mining Co. The cylinders are 15 inches in diameter by 24 inches stroke. It is similar to the hoisting engines described on page 19, differing only in being of larger dimensions and being operated from a raised platform instead of from the floor. Like the others, it has post brakes, band friction clutches, column indicators, etc., as well as helical-tooth gears, by means of which increased strength and smooth running qualities are obtained. Details of dimensions, capacities, etc., will be found in the table on page 20.

Plate No. 1051.



Special Double Cylinder, Double Drum, Geared Hoisting Engine.
Direct Acting Double Drum Hoisting Engine.

24x60 DIRECT-ACTING DOUBLE DRUM CORLISS HOISTING ENGINE.

Plate 1267 illustrates a modern type of hoisting engine built for the Le Roi Mine of the British American Corporation located at Rossland, British Columbia.

The cylinders are 24 inches in diameter by 60 inches stroke and drive two straight-faced drums each 10 feet in diameter by 5 feet face.

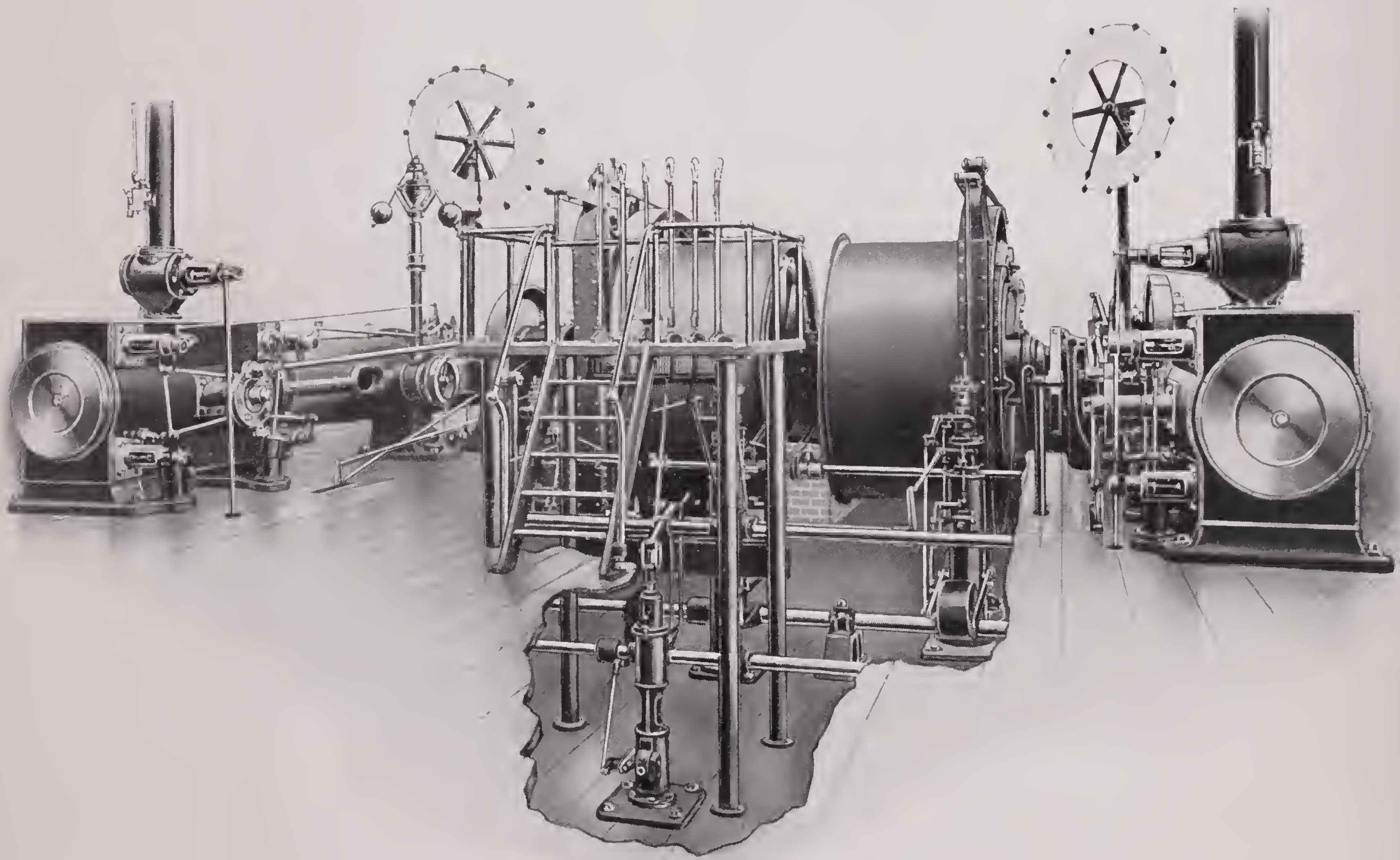
Each drum is provided with a powerful post brake and a band friction clutch. The drums are loose on the shaft and are driven from it by means of friction clutches. The reversing gear, clutches, brake and throttle are all operated by means of auxiliary engines fitted with an oil cataract device for checking and locking their motion.

The disc cranks are made extra large and fitted with band brakes operated by a foot lever on the engineer's platform.

An automatic safety stop driven by the same mechanism that operates the indicators actuates the cut-off so that in case of overwinding no steam can enter the steam cylinders while at the same time the brake engines are operated to bring the hoist to a stop.

This hoisting engine is capable of raising an unbalanced load of 14,250 lbs. from a

Plate No. 1267.



Direct Acting Double Drum Hoisting Engine.

depth of 2,000 feet with the angle of the shaft 67 degrees from the horizontal. This engine has been in operation for 4 years, during all of which time it has given perfect satisfaction.

It is interesting to note that steam for this plant is carried about 1400 feet from the boilers and as a result contains a large percentage of moisture.

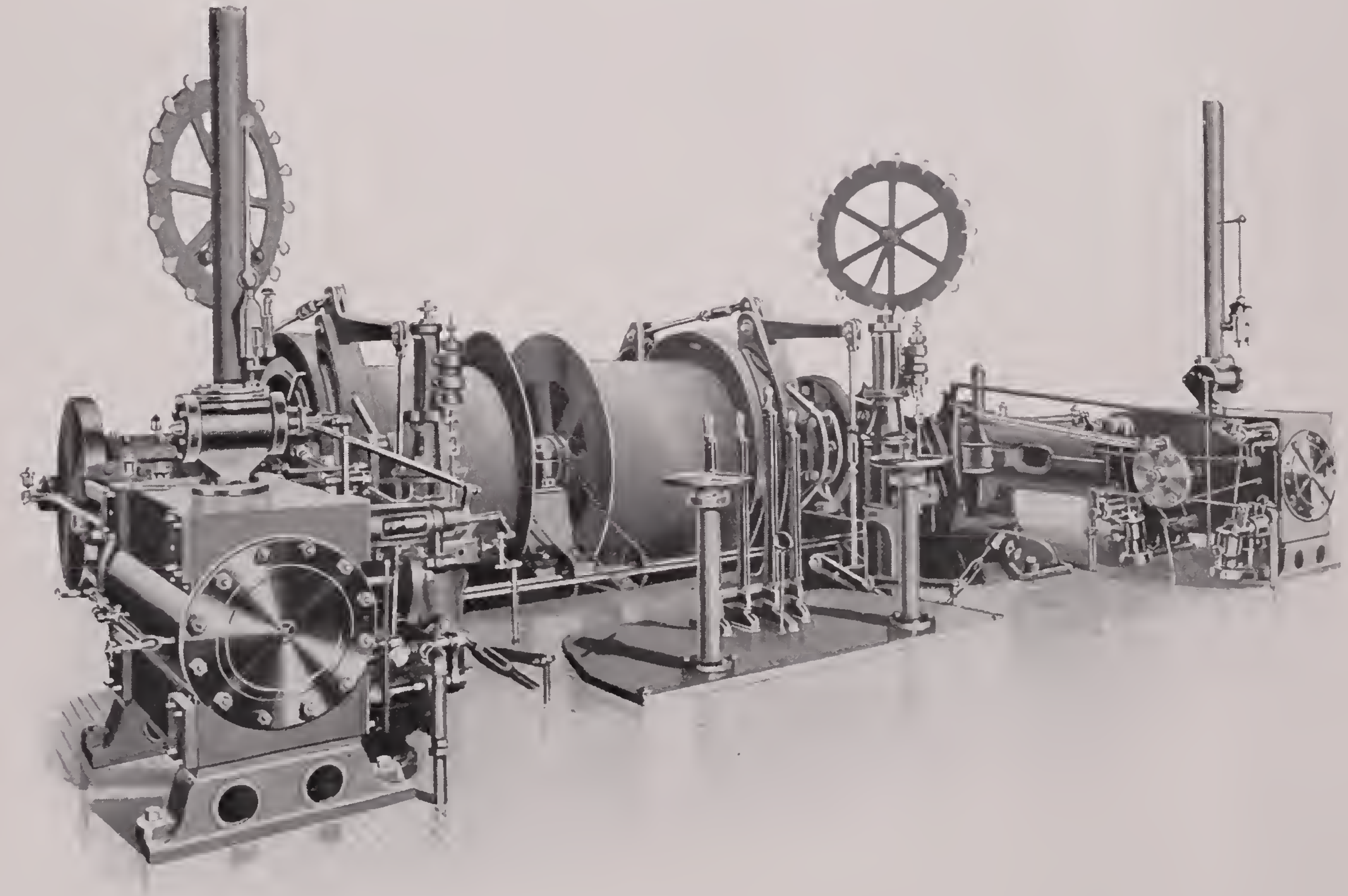
We have built a hoisting engine of the same general design for the Consolidated Bonanza Gold Mines Co. with steam cylinders 20 inches in diameter and a 48-inch stroke, driving two drums each 6 feet in diameter with 7-foot faces.

DIRECT ACTING, DOUBLE DRUM HOISTING ENGINE.

Plate 1085 shows one of our Direct Acting Double Drum Hoisting Engines built for the Virtue Consolidated Mines. The cylinders are 16 in. by 36 in., Corliss type. The drums are 60 in. diameter and 48 in. face. The operating levers are grouped together between the cylinders on the platform on the floor level. The friction clutches, link reversing gear, throttle and release valves are all operated by hand, while the post brakes are operated by auxiliary steam cylinders, fitted with an oil check.

This engine is designed to hoist a total load of 6000 pounds at a speed of 1250 feet per minute, from a depth of 1500 feet.

Plate No. 1085.



Direct Acting Double Drum Hoisting Engine.

CONICAL DRUM HOISTING ENGINES.

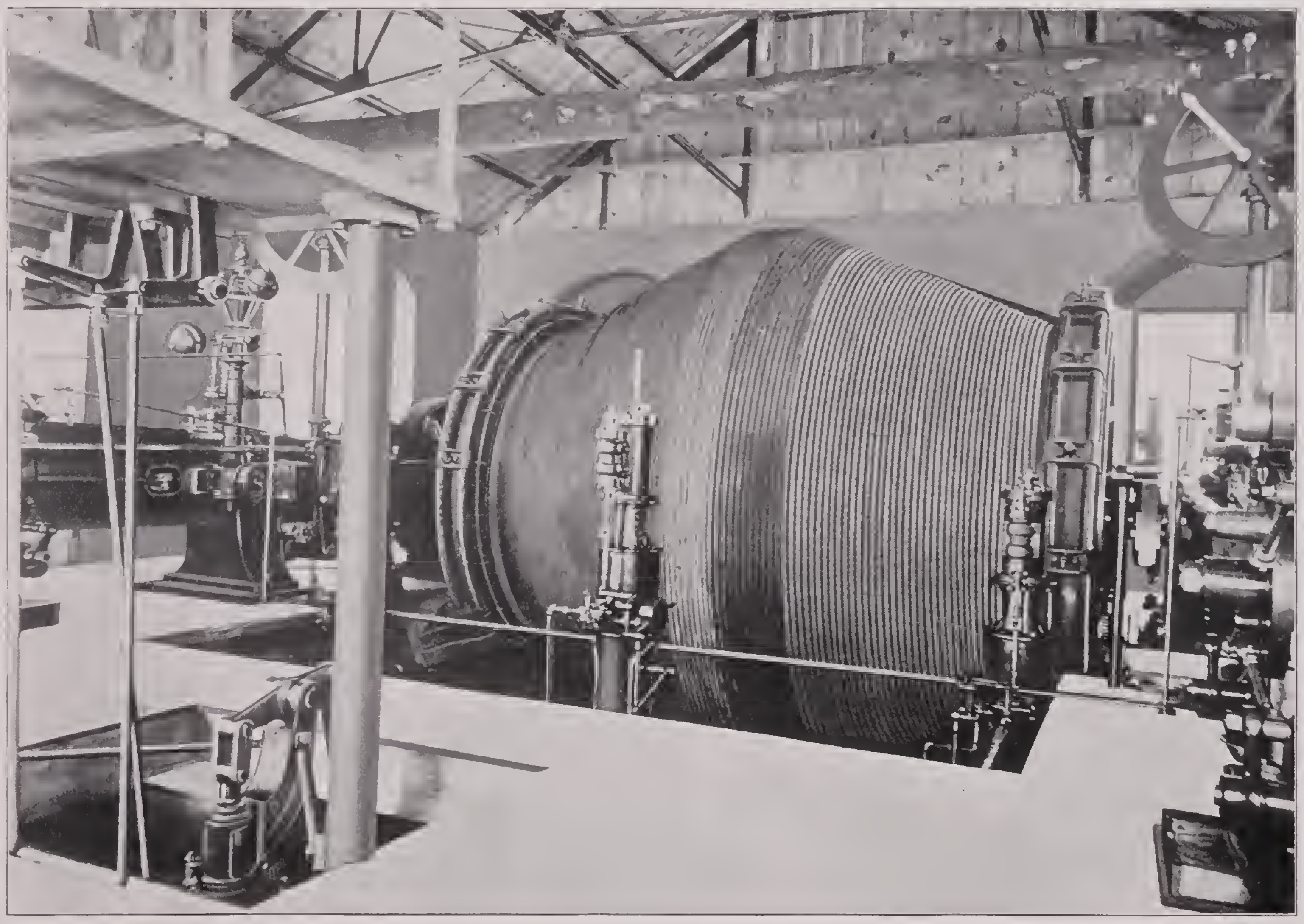
DOUBLE CONE DRUM ENGINE.

The Double Cone Drum With Two Ropes Is a Development of the Single Cylindrical Drum.

The theory of this construction is that as the weight of the rope increases, the radius at which it acts correspondingly decreases, thus equalizing the work of the engine. The dimensions of the drum must be calculated to suit each particular case, and if used under different circumstances, the drum would fail to fulfill the purpose of its design. For very deep hoisting, in order to balance the great weight of rope, the central portion of the drum would become inconveniently large in diameter, therefore this portion is made cylindrical and is used by both ropes. This arrangement also shortens the drum, but of course makes it impossible to perfectly balance the weight of the rope.

Plate 940 shows the first of two Conical Drum Hoisting Engines built by us for the Atlantic Mining Company. The drum measures 10 ft. in its smaller diameter and 15 ft. 6 in. in its larger diameter. It is fixed on the shaft and provided with take-ups for adjusting the lengths of the ropes. The brakes are steam operated and of the band type. The cylinders are of Corliss type, 26 in. by 48 in., being designed to form the low pressure cyl-

Plate No. 940.



Conical Drum Hoisting Engine.

inders of a duplex tandem compound engine, the high pressure cylinders of which will be added later. A cut-off governor adapted to hoisting engine work controls the speed.

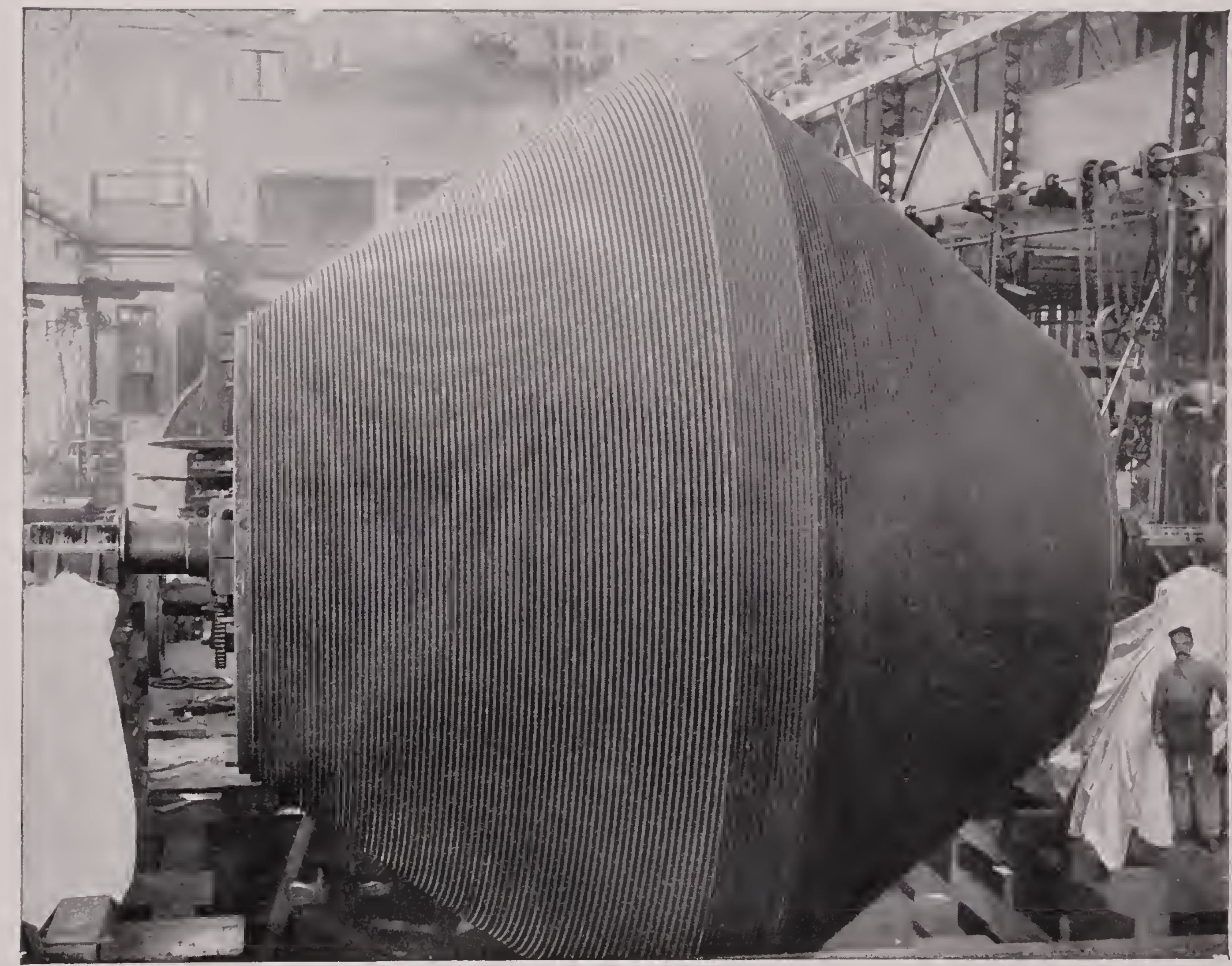
The capacity of this hoisting engine running in balance, is 7000 pounds of ore hoisted at an average speed of 2400 ft. per minute, up an incline of 55 degrees from the horizontal, 2000 feet in length.

DOUBLE CONICAL DRUM.

Plate 1006 shows the drum for the second Conical Drum Hoisting Engine built by us for the Atlantic Mining Company. This is one of the largest of its type ever built.

This Hoisting Engine is similar to the first one built for the same Company (see page 24), except that it is larger in every respect. The drum measures 12 ft. in its smaller diameter and 25 ft. 6 in. at the center by 25 ft. 5 in. face. The cylinders are 24 in. by 60 in. and the capacity is 7000 pounds of ore hoisted at an average speed of 3400 ft. per minute, up an incline of 55 degrees from the horizontal, 4000 feet in length.

Plate No. 1006.



Double Conical Drum for 24 In. x 60 In. Corliss Hoisting Engine.
Built for the Atlantic Mining Co.
Diameter 25 ft. 6 in. at the Center; 12 ft. at the Ends.

ADVENTURE CONSOLIDATED COPPER CO., AND BALTIC MINING CO. HOISTS.

In addition to the hoists shown in this catalogue, we have installed two double cone drum hoisting engines for the Adventure Consolidated Copper Co., and one for the Baltic Mining Co. The hoists for the Adventure Consolidated Copper Co. are of the double cone drum duplex Corliss Direct Acting Hoisting engine type, steam cylinders 24 in. diameter by 60 in. stroke, driving a double cone drum 10 ft. in diameter at the smaller end and 13 ft. 8 in. in diameter at the larger end, grooved for 1¼ in. rope, each half of the drum to carry 2000 feet of rope. The drum is fitted with a single post brake 15 ft. 4½ in. diameter by 12 in. face. This brake will be of the parallel motion type operated by means of an auxiliary steam cylinder fitted with an oil check. The reversing motion will be of the Allen Straight Link type operated by means of an auxiliary steam engine. The engine frames are constructed so as to have a bearing along the entire length of the frame, thus making an extremely rigid construction. Each end of the drum is fitted with a rope take-up so that the length of rope in use can be varied. This take-up is entirely independent of the drum and is easily accessible. The throttle valves used on these hoisting engines are of a special balanced design, the valve being so perfectly balanced that it can be operated with ease by means of a hand lever, and at the same time is absolutely tight. Each of these hoisting engines has a capacity for a total load of 24900 lbs. hoisted at a speed of 2000 ft. per minute up a shaft having an inclination of 45 degrees from the horizontal.

The hoist for the Baltic Mining Co. is practically a duplicate of the above described engine, with the exception that the drum is 10 ft. diameter at the smaller end and 15 ft. diameter at its center. This hoisting engine has a capacity of a maximum gross load of 19000 pounds, hoisted at a speed of 2000 feet per minute up a shaft inclined at an angle of 73 degrees from the horizontal.

HOISTING FOR DEEP MINES.

THE WHITING SYSTEM.

When mining is to be done from very great depths, the problem of hoisting ore becomes much more difficult than that met with in ordinary mines. A flat rope, under such circumstances, is not very successful, owing to the great cost of repairs on such a rope. A round rope, as a rule, requires very large drums, since with deep hoisting it is not a good plan to coil the rope in more than one layer on the drum. To overcome these objections, Mr. S. B. Whiting many years ago introduced a system of hoisting by means of drums similar to those used for cable railways. According to this system the rope passes several times around two drums which, as a rule, are both driving drums. One end of the rope is made fast directly to the hoisting cage or skip, while the other end first passes around an idler sheave located on a carriage, and thence to the other shaft compartment. By means of the carriage the positions of the two skips or cages can be altered so as to suit the different levels in the shaft.

Considerable difficulty has been experienced with this system due to an unequal wear of the different grooves in the drums with the grooves filled with wood. We have of late

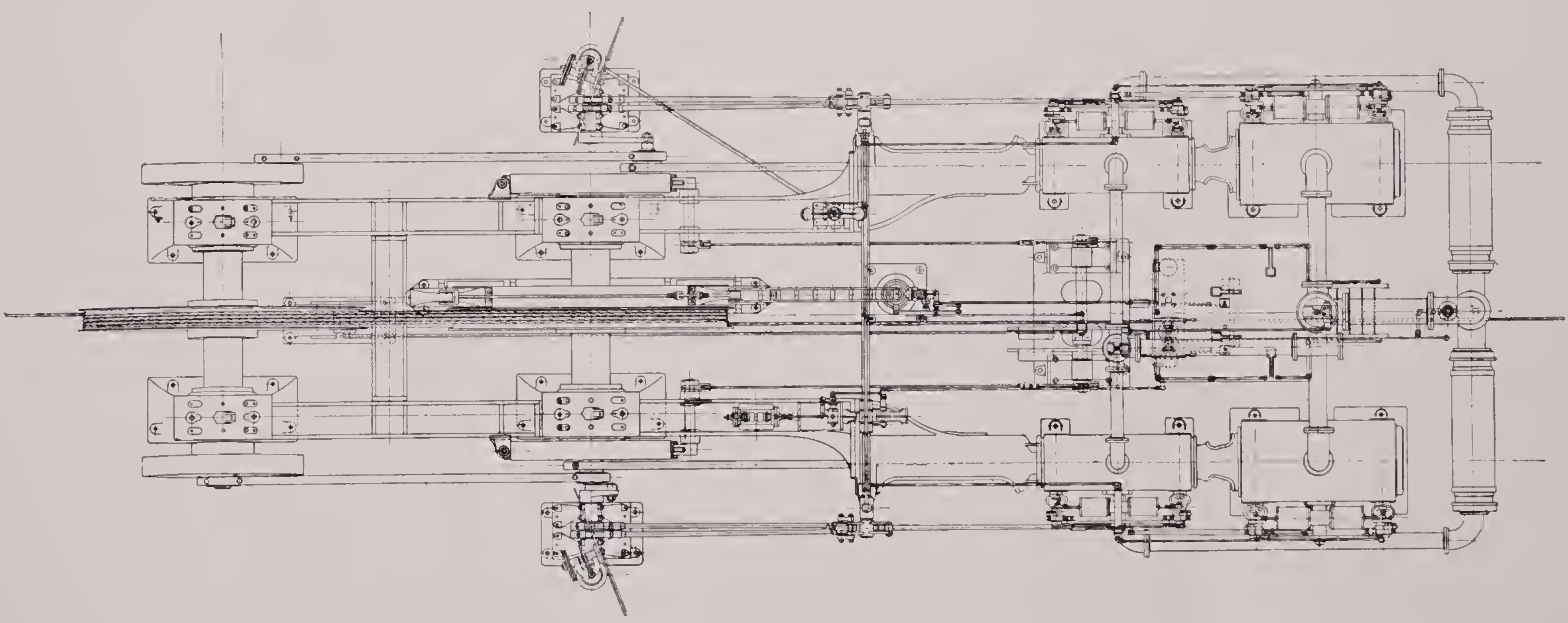
years entirely overcome this unequal wear by using Walker's patent differential rings on the drums instead of the common wood filling. These patent rings retain their correct diameters for long periods and have given most satisfactory results.

The Whiting system offers a very great advantage over any other system in that the exact maximum depth of the mine need not be known at the time when the hoisting engine is built, since, within the limits of strength, more rope can be added to suit requirements. In the case of a drum, or flat rope reel, this cannot be done because the size of the drum or reel absolutely determines the quantity of rope that can be used. In the Whiting, however, the reel does not hold the rope, but simply takes a few wraps of it and is independent of its length.

One difficulty still remained to be overcome. That was the variable dead weight of rope when hoisting from different levels. When the cage is at the bottom not only must its own dead weight and that of the ore be hoisted, but in addition to this the full weight of the rope, which diminishes as the cage nears the surface. On the other hand, the rope on the descending side becomes heavier as the cage goes down, and the result is that it takes a very great effort for the hoist to start the cage or skip from the bottom, while as the ascending cage nears the top, the descending cage and rope may even more than balance the total weight of the former, so that the engine of the hoist has no work to do during that period. The result is of course very poor economy, and it renders it almost impossible to use compound engines, which system is now in such general use for ordinary mill engines.

In order to overcome this difficulty, a "tail rope" has been introduced, this being a rope of the same size and weight per foot as the main hoisting rope. The two ends of this rope are fastened respectively to the bottoms of the two skips, and at the bottom of the shaft the rope passes around a sheave placed in guides or on a carriage, according to circumstances. This tail rope absolutely counterbalances the hoisting rope, while one skip exactly balances the other skip. The load on the engine, therefore, at all times is only the amount of ore that

Plate No. 1096.



Whiting System Hoisting Engine.—Plan View.

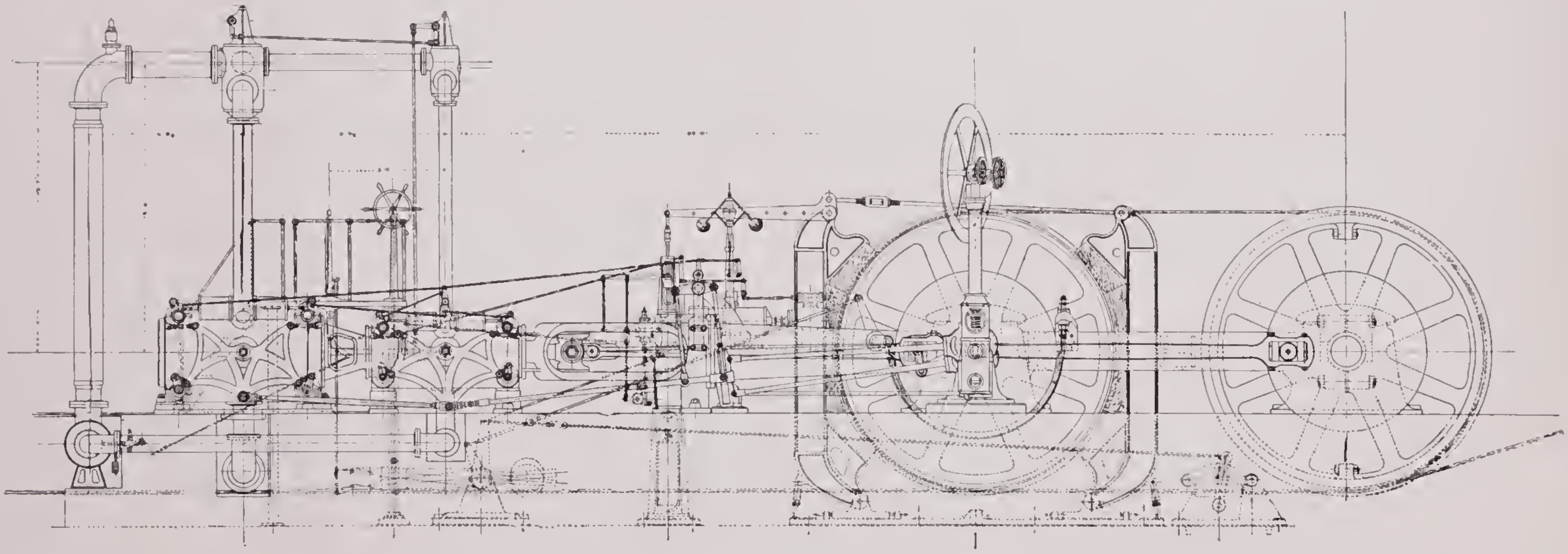
is being hoisted, irrespective of either the weight of the rope per foot, the weight of the skip or the depth of the mine.

This is of much greater advantage than would at first sight appear. It allows the use of the smallest possible engine. The engine can be proportioned for the highest economy, since the work is constant. A further advantage, which in many cases is the greatest, lies in the fact that the engine in a great measure becomes universal. That is to say, that identical engines can be used for any depth of mine up to the limit of the strength of the engine and rope. It often happens that one mining company operates a number of separate mines, or, at least, separate shafts, and the great advantage of having a hoist which can be used equally well at any of these mines, is apparent. It was these considerations which led to the adoption of this system for the Rand Mines, Johannesburg, South Africa, after they had tried almost every conceivable system of hoisting that had been devised. At these mines the Whiting system is used, not only for hoisting rock from completed shafts, but deep shafts have been successfully sunk with such engines, during which period, of course, the tail rope could not be used to advantage. In some cases, however, it may be preferable to employ straight drums of small diameter for sinking purposes, these drums temporarily taking the place of the Walker drums.

In the Whiting hoists both winding drums are positively driven by the engine. The first drum is driven directly by the main connecting rods, while the second drum is driven by means of a pair of parallel rods similar to those used on locomotives. Owing to the slightly inclined position of the second drum shaft, these parallel rods, however, have to be made with a simple compensating device to avoid binding. In this manner both drums become driving drums and the greatest possible amount of driving friction on the rope is obtained. Only one of the driving drums needs to be provided with a brake wheel, since the brake power is transmitted through a shaft and through the parallel rods to the other drum just as effectively as if a separate brake had been provided for it.

It is evident that the engine part of such a hoist can be varied to suit conditions and circumstances. In most cases we would advise the use of a cross compound Corliss engine

Plate No. 1095.

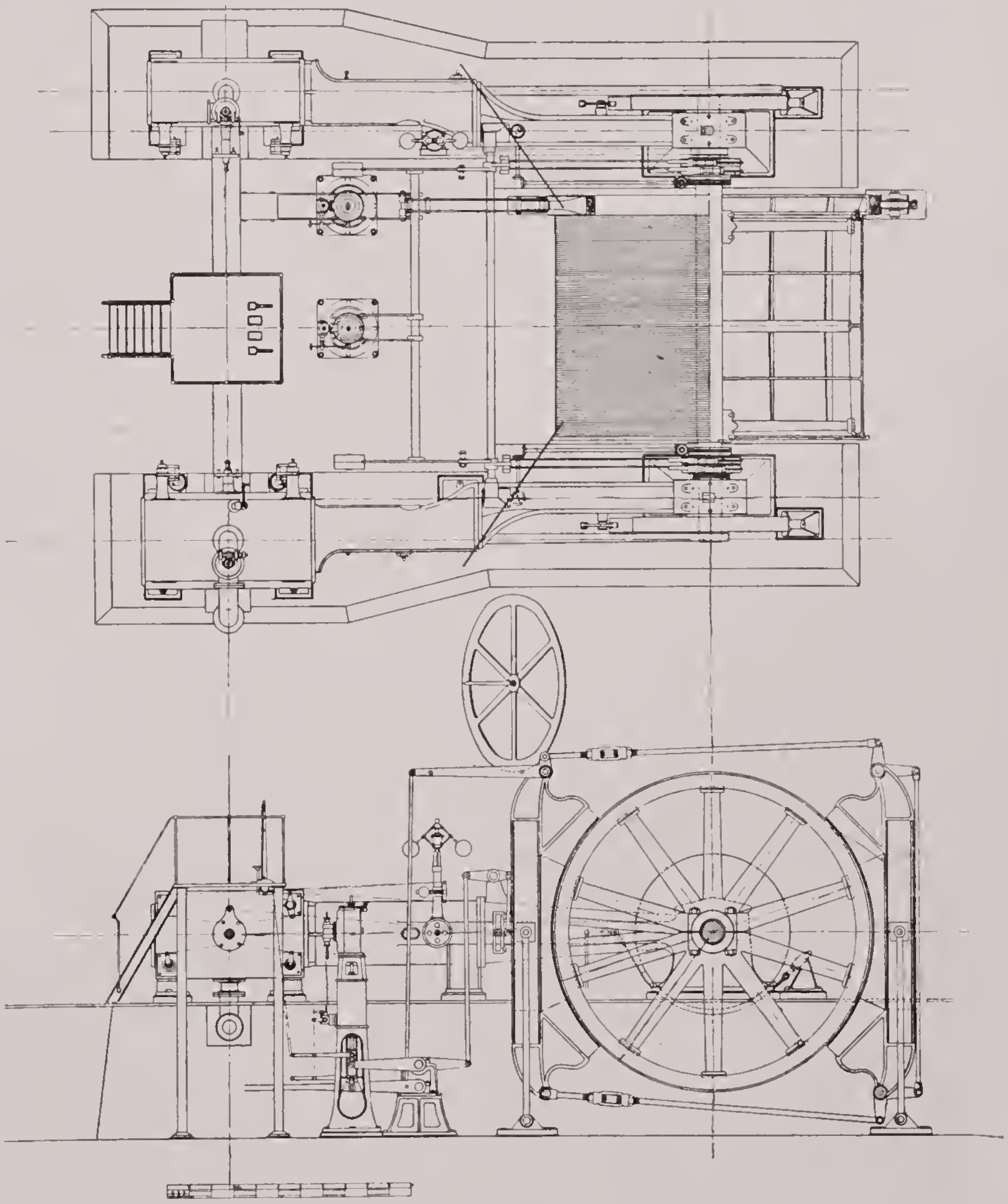


Whiting System Hoisting Engine Elevation.

with one high pressure and one low pressure cylinder. Our illustration shows a double tandem compound Corliss engine, which, at the expense of simplicity, offers the advantage of an absolutely uniform starting moment on the two cranks under any condition of load. Where economy of first cost is of more importance than economy of running, a plain pair of high pressure cylinders may be used instead of compound cylinders. It is also quite possible to arrange this engine as a four-cylinder triple expansion, though in most cases we think it will be found that the compound type answers all requirements for economy.

The adjustment for different levels is effected by means of the take-up gear, consisting of (a), a sheave placed on a carriage, and (b), of winding machinery for shifting this carriage along its track. The track for this carriage is very wide, and the sheave is placed preferably in a horizontal position. While hoisting, this carriage is clamped to the track, and is in addition held by means of the rope by which it is adjusted. This rope may run over a tail sheave at the end of the track from which it is led to the winding engine, which may then be located in the engine room with the main hoist. This winding engine consists of a drum driven by a very powerfully geared engine, because the strain on this rope is considerable. The length of

Plate No. 1094.



Compound Direct Acting Corliss Hoisting Engine.

track required for this take-up gear is just one-half of the length of the adjustment required in the mine, so that if it is desired to vary the position of the cage in the shaft 1000 feet, it will be necessary to have a track 500 feet in length.

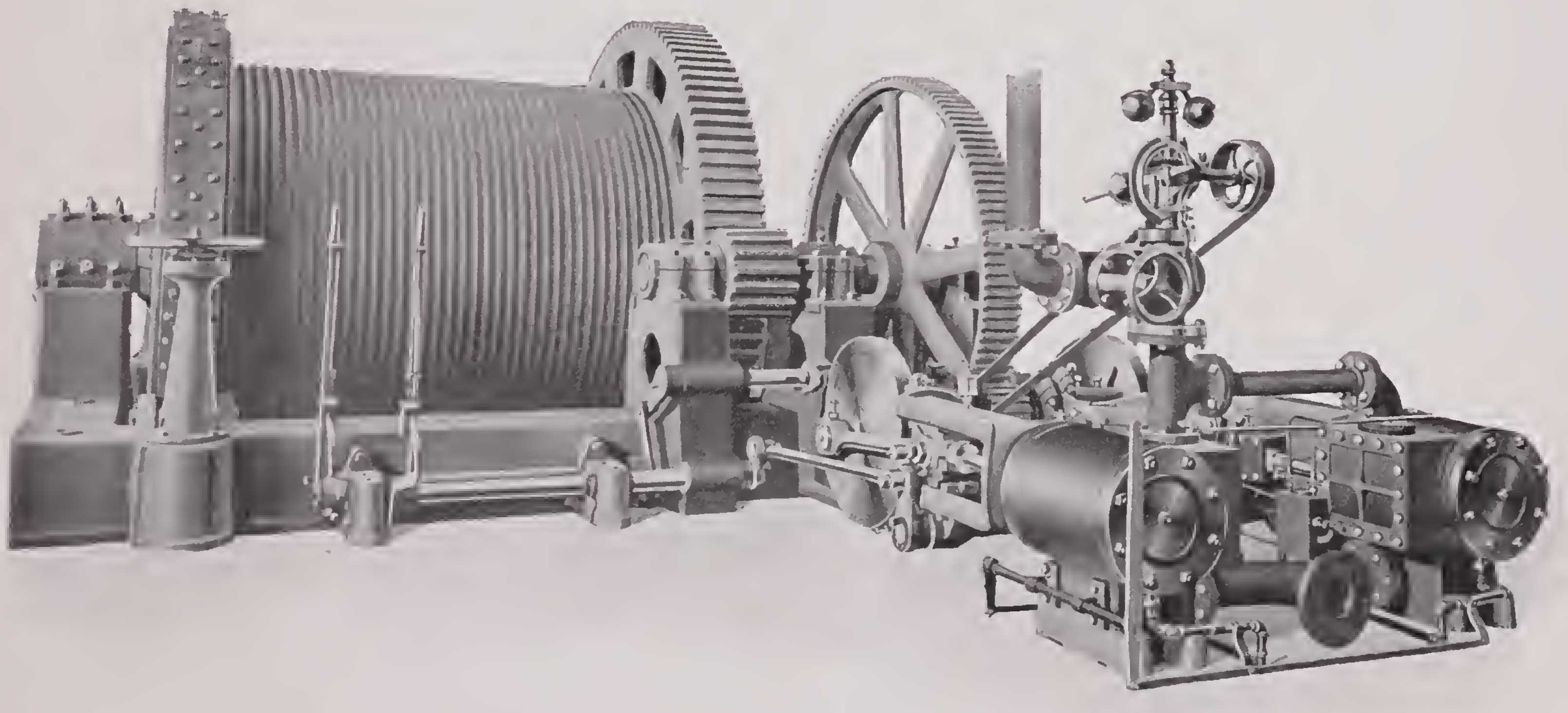
On page 29 is shown a modification of this system which, under some conditions, may be preferred to the Whiting hoist. This hoisting engine has one large drum keyed to the crank shaft. One rope is fastened to one end of this drum, and the other rope to the other end in such wise that one rope will always wind on while the other winds off.

One of these ropes is taken directly to the head gear while the other is first laid over a take-up gear similar to that used for the Whiting system. From this it will be seen that exactly the same advantages are to be gained by this system as by the Whiting, with the single exception that this drum hoist cannot be used for a greater depth than that for which its drum is built. Offsetting this disadvantage is found the advantage of having both ropes positively fastened to the drum so that in case an accident should happen to one rope, only the skip on this rope is dropped, and not both, as would be the case with the Whiting hoist. In other respects the description of the Whiting system applies, and so far as economy is concerned, one system stands just as high as the other. With either system we always furnish an automatic governor which controls the cut-off and insures a uniform speed. This governor is so arranged that it will automatically throw the cut-off gear out of action while the hoist is being slowed down, so that in all cases the engine may be left in the best possible condition for starting up again after it is stopped.

FLEETING ENGINE.

Plate 1268 illustrates a double geared single drum hoisting engine, used in connection with the Whiting hoists illustrated on pages 27 to 29. These engines are called Fleeting

Plate No. 1268.



Fleeting Engine.

Engines because their duty is to fleet or traverse the movable tail-rope sheave which is used for adjusting the length of the rope; or, in other words, adjusting the depth from which the main engine is to hoist. This is something that is only done occasionally, and it is therefore necessary to have a machine which can be operated at a slow rate of speed a few times a day, but the machine must be extremely heavy and substantial, as it has to lift the same load as the main engine. Speed being no object, however, it is possible to use a small geared engine. The cylinders of this engine are 10 in. diameter by 12 in. stroke, which drive by means of gearing a drum 6 ft. diameter by 6½ ft. face, grooved for 1½ in. rope, the gear ratio being 75 to 1. The drum is provided with an extremely powerful band brake operated by means of a hand wheel. The crank discs are also fitted with band brakes.

WALKER'S PATENT DIFFERENTIAL ROPE DRUMS.

Plate 1270 shows a "Walker" Patent Differential Rope Drum such as we use on hoists of the "Whiting" type.

It has been found that when a driving rope makes a number of wraps around grooved solid drums each groove will wear down at a different rate from the others. This necessitates a periodical turning out of the grooves and the ultimate replacing of the entire drum. Furthermore while the drum is running with its grooves of varying diameters tremendous strains are set up in the rope and great wear on the rope results in consequence of the slip, due to the differences in the circumference of the wheel at each groove. To eliminate these objections the "Walker" Differential Drum was devised. Each groove of this drum is turned in an independent ring (usually of forged iron) which ring is free to rotate on the drum center, thus equalizing the tension on the different wraps of the drum. At the same time with a proper number of rings, the friction of one against the other, and of all upon the cast iron center is sufficient to transmit the entire power the rope will carry. To prevent cutting, provision is made for a slight lubrication of the bottom and sides of the rings. A covering plate is provided for holding the rings in place, which plate is not shown in the annexed cut.

For high peripheral speeds such as are common with "Whiting" hoists, and under the conditions necessitating the making of the ring in halves, the rings are frequently constructed to interlock. This being an extra precaution against the accidental shearing of the joint rivets by centrifugal stresses.

Experience has fully demonstrated that differential rings are absolutely essential on a hoist of the "Whiting" type, and we, therefore, use these rings on all "Whiting" hoisting engines built by us. We have also furnished them to other companies building or operating this type of machine. Among important installations using these differential rings are the mammoth hoisting engines at the Red Jacket Shaft of the Calumet & Hecla Mines which are provided with four drums 19 ft.-1½ in. diameter and two 7 ft. diameter, all fitted with "Walker's" Differential rings; and the five large double tandem "Whiting" hoisting engines built by us for the Rand Mines of South Africa described on pages 42 to 44 of this catalogue.

Plate No. 1270.

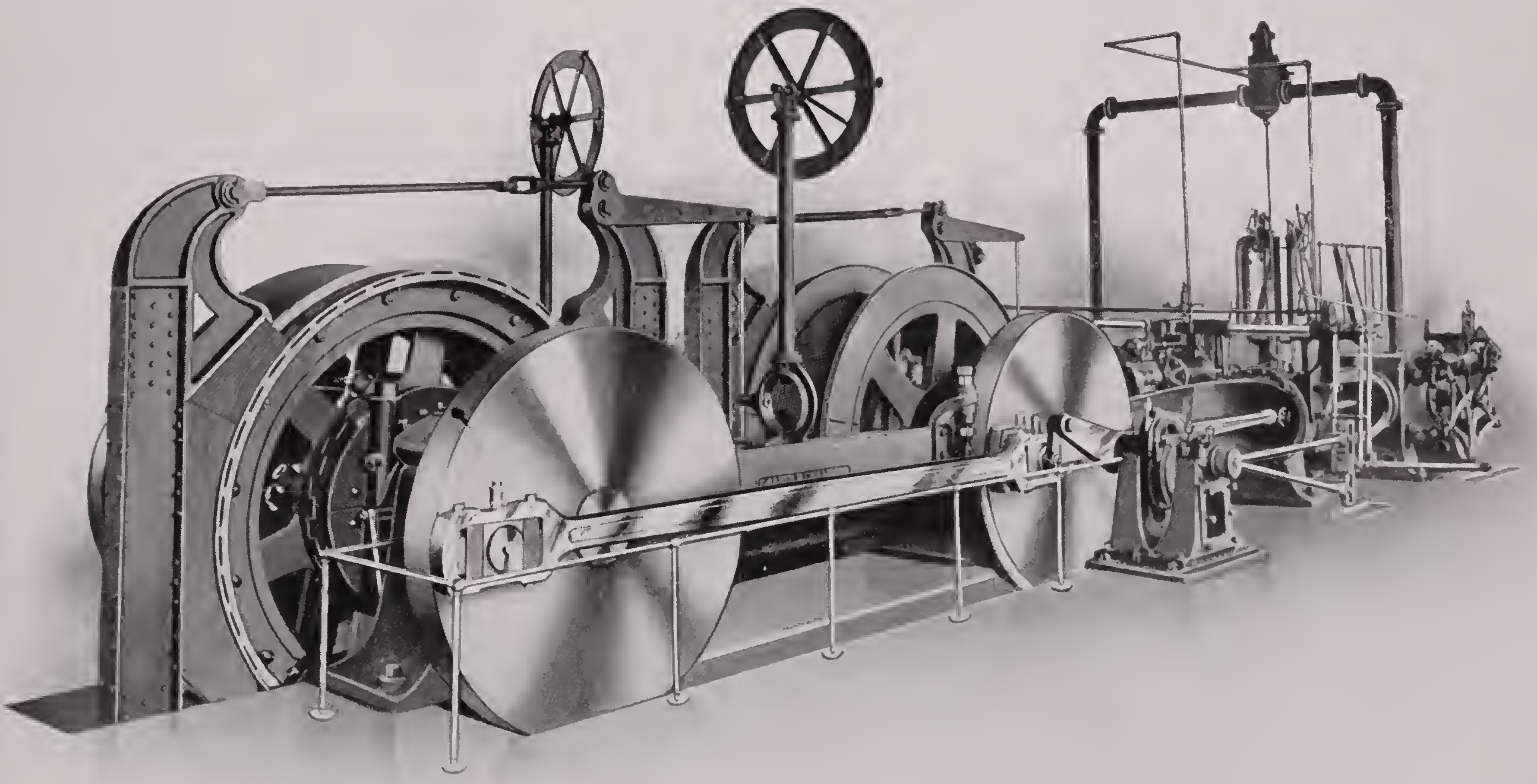
Walker's Patent Differential Rope Drums.

SPECIAL DIRECT-ACTING DOUBLE DRUM HOISTING ENGINE.

Plates 1266 and 1267 show an engine which was so designed that its character could be changed almost entirely after the first work for which it was built—that of sinking the shafts—was finished.

In its original form it was a simple engine with cylinders each 17 in. in diameter by 60 in. stroke—driving two drums each 8 ft. in diameter by 2 ft. 8 in. face. The drums were especially designed to permit of overwinding four coils of rope so as to hold 5,000 feet of 1⅛ in. rope. Each was fitted with a powerful post brake and Seymour jaw clutch. In this form it was used while the shafts were being sunk. When this work was finished the engines were converted into duplex tandem compound engines by the addition of 28-inch low pressure cylinders.

Plate No. 1266.



Special Direct Acting Double Drum Hoisting Engine.

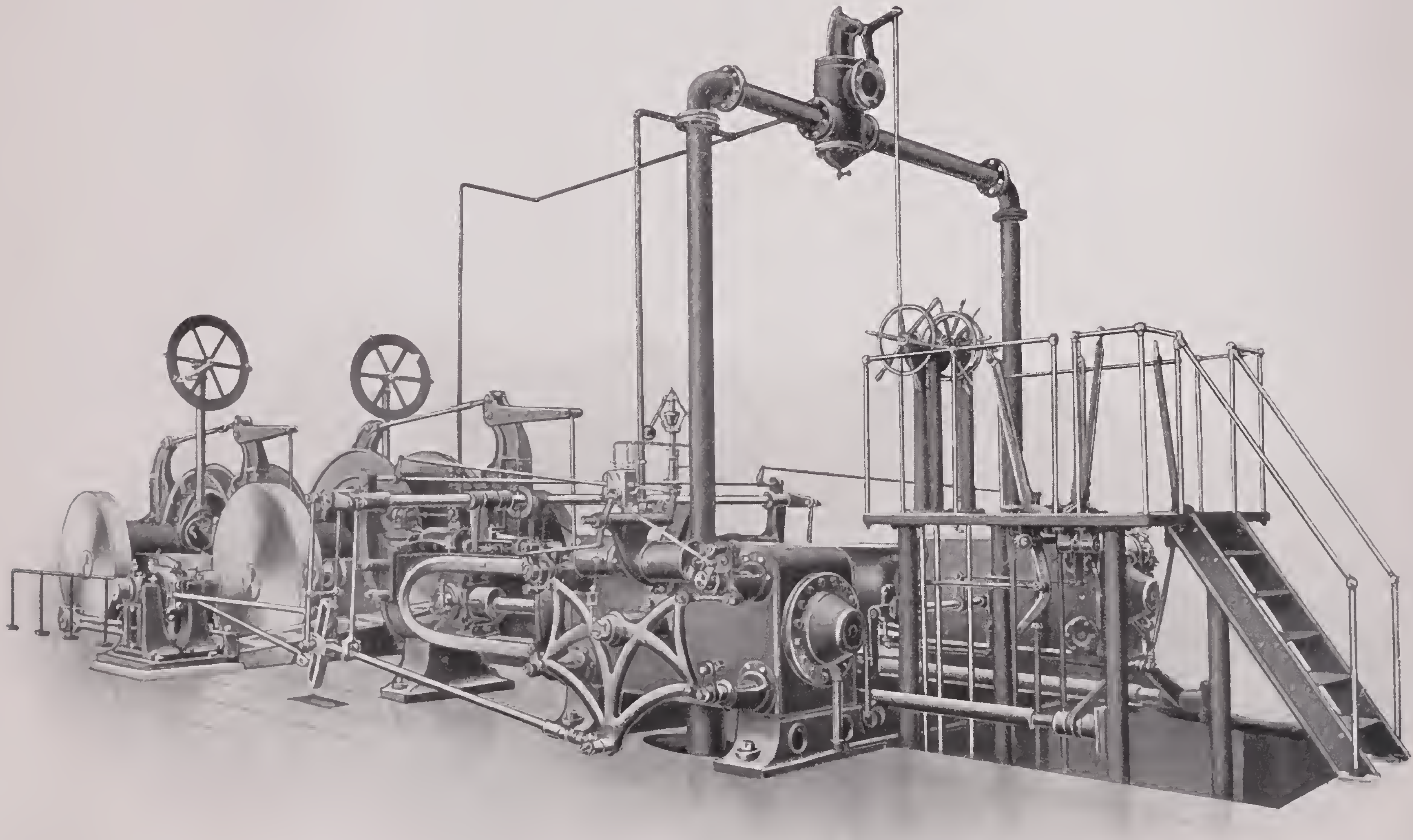
Original form while sinking shafts.—As seen from drum end.

At the same time the straight-faced drums were taken out and replaced by Whiting drums, converting the entire machine into a hoisting engine of the type shown in plates 1095 and 1096 on pages 27 and 28. The peculiar arrangement of the valve gear shown was adopted in order to cut down the length between the bearings on the crank shaft. This was done in order to make the shaft better able to resist the numerous blocking strains which it has to resist as a Whiting hoist.

The reverse motion is actuated by an auxiliary steam cylinder having an oil cataract cylinder.

Orders were received for five more hoists of this type while this catalogue was in preparation and these were in course of construction at the time of going to press. These five hoisting engines are similar in all respects to the one described except that they were to be built tandem-compound engines at the beginning.

Plate No. 1267.



Special Acting Double Drum Hoisting Engine.
Original form while sinking shafts.—As seen from steam end.

REEL HOISTING ENGINES.

HOISTS USING FLAT ROPE.

GEARED AND DIRECT ACTING ENGINES.

The Reel Hoist is often used where it is not the intention to hoist always in balance and where no tail rope or compensating device, such as a conical drum, can be used.

The greatest weight to be lifted by any hoist is when the loaded cage is at the bottom of the shaft and consequently all the rope is off the drum or reel, but at this point the reel hoist has an advantage, since the reel begins to wind on its smallest diameter. As the rope winds on the reel the total load decreases while the leverage of the rope on the reel increases, thus keeping the load on the engine nearly uniform when lifting one cage unbalanced. Another advantage of the reel hoist is that the rope always leads straight to the head sheave instead of at a considerable angle as occurs when winding on a drum.

This enables the hoist to be put very close to the shaft, which is a great advantage where the contour of the ground is such that expensive grading is necessary in order to prepare a site for the hoist. In cold climates it is an advantage as the hoisting engine and gallows frame can be placed under the same roof.

Reel hoists are found in use mostly in the western part of America, where they are in great favor. As a rule, hoisting is done there from many different levels. One car is often being hoisted from one level while the car on the other deck may come from another level. Under such circumstances, it is of course out of the question to hoist in balance, and the flat rope reel hoisting engine becomes very convenient.

Allis-Chalmers Co. have built a great variety of reel hoisting engines, both direct acting and geared, driven by Corliss, Piston and Slide Valve Engines, and for large as well as for small loads.

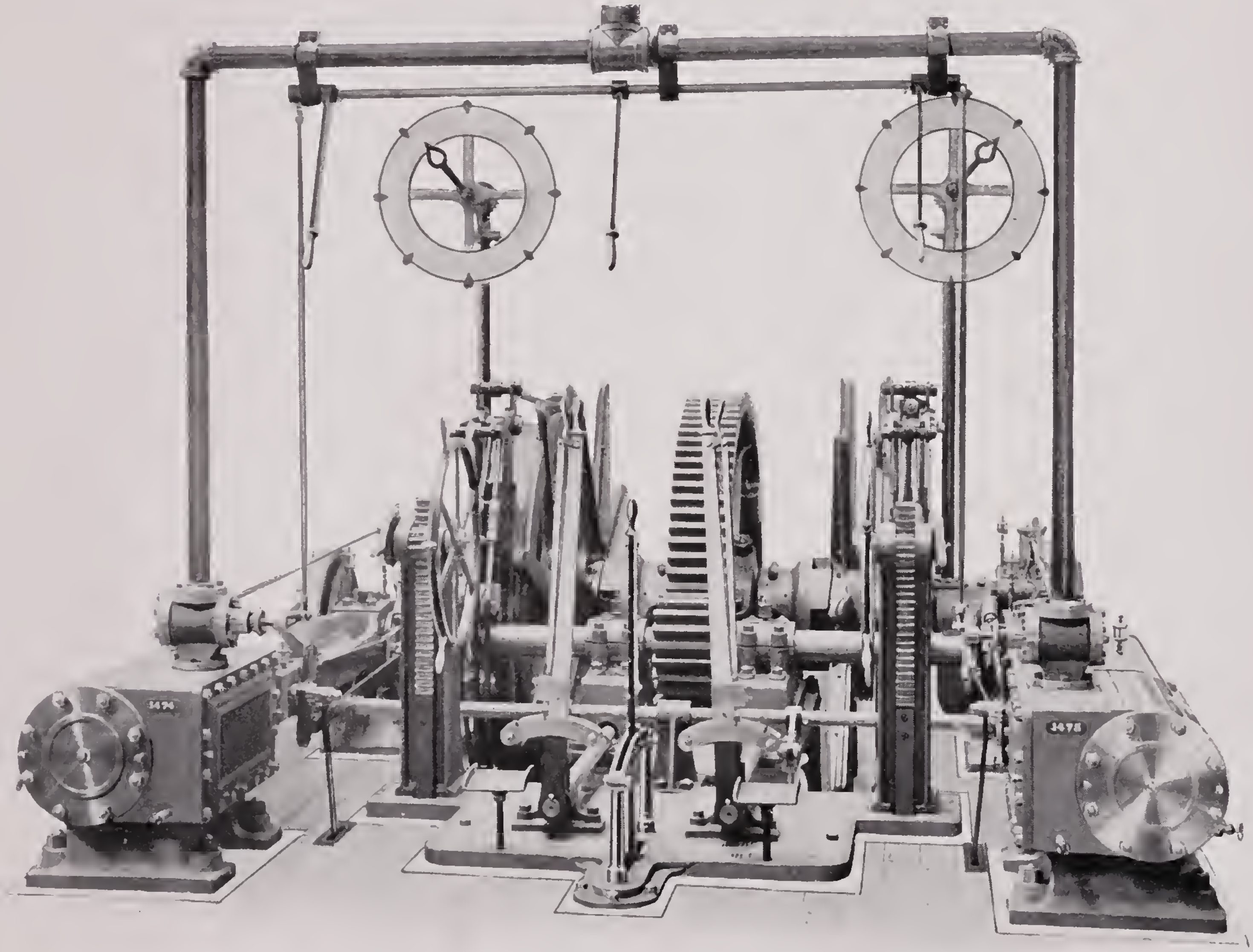
On the following pages are given illustrations and descriptions of these various types.

GEARED, DOUBLE REEL HOISTING ENGINE.

Plates 1056 and 1057 illustrate a Double Reel, Single Geared Hoisting Engine built for the Diamond Mine. The cylinders of the engine are duplex, 10 in. diameter by 16 in. stroke, with slide valves and link motion reversing gear.

The outside arm of the reel and the brake ring are cast in one piece, thus mutually

Plate No. 1056.



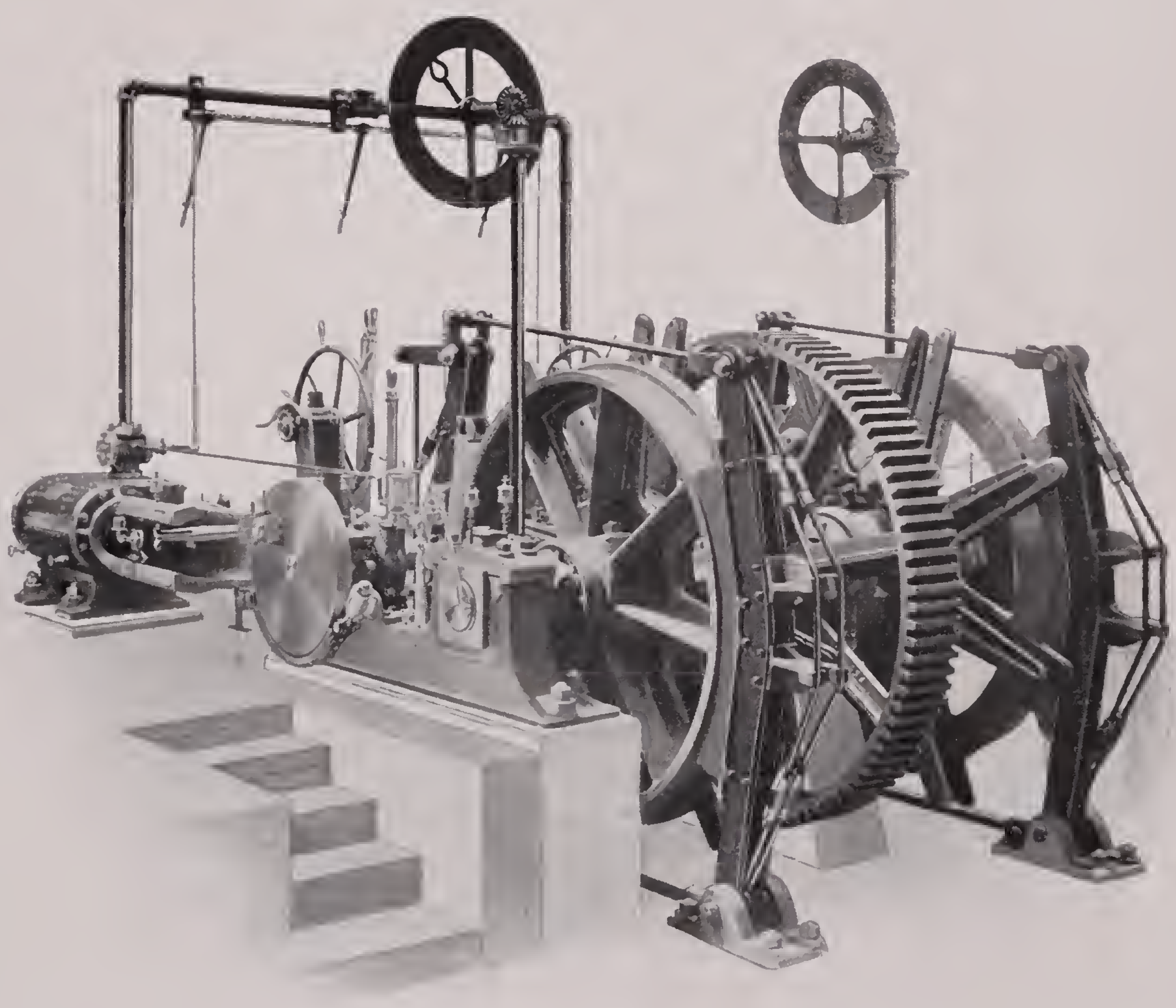
Double Reel, Single Geared Hoisting Engine.—Cylinder End.

strengthening these parts and producing a compact and efficient hoisting engine.

The brakes are of the post style and are applied by means of hand wheels with rack and pinion. The hoist is also equipped with crank brakes operated by pedals. Jaw clutches drive the reels, and each reel has a dial indicator positively driven from the reel hub by means of a screw and worm, for showing the position of the cages.

The reels are 30 in. diameter at center and are each suitable for holding 800 feet of 3 in. by 3/8 in. flat rope.

Plate No. 1057.



Double Reel, Single Geared Hoisting Engine.—Crank End.

DOUBLE REEL, DOUBLE GEARED HOISTING ENGINE.

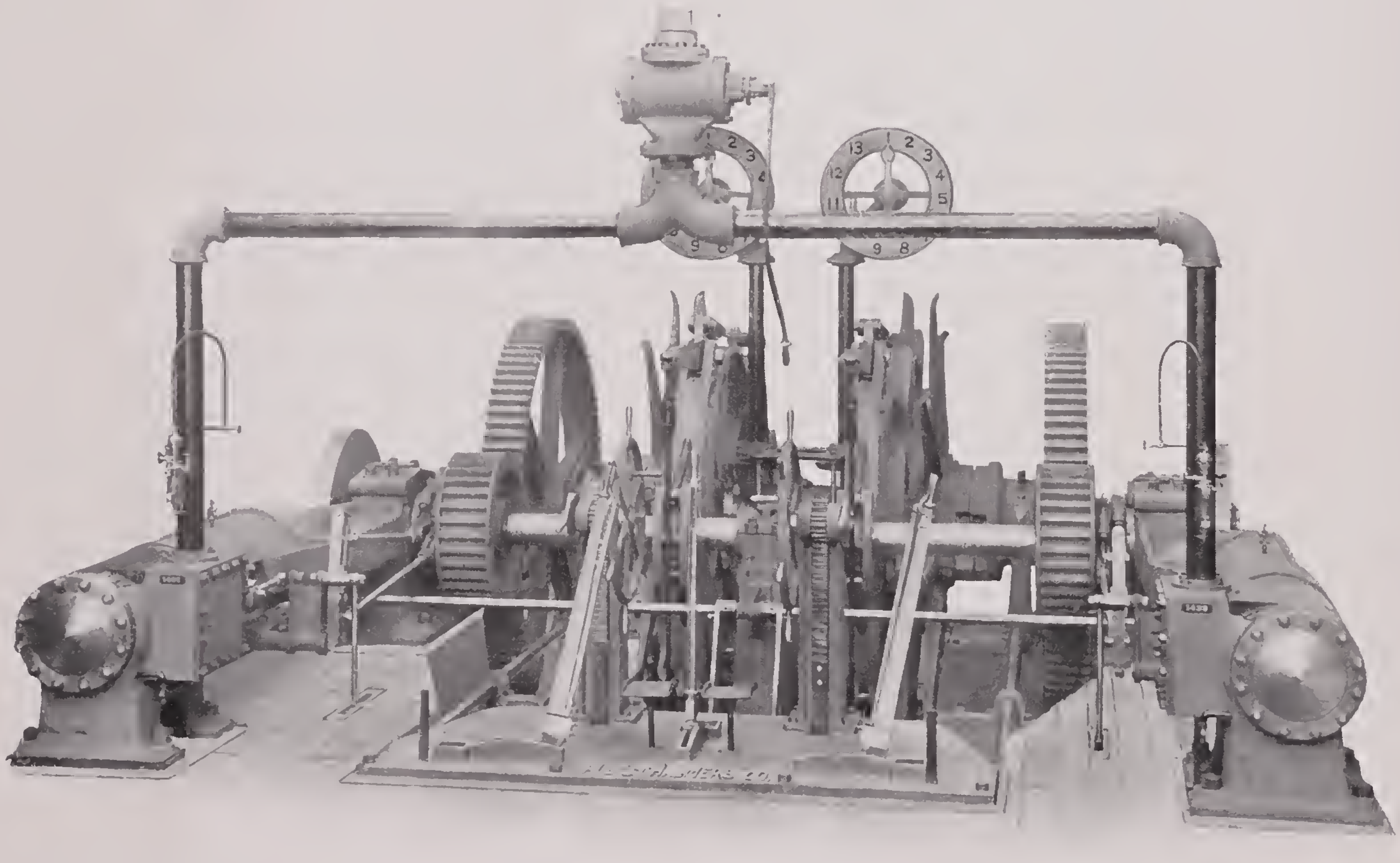
Plate 1064 illustrates a Double Reel, Double Geared Hoisting Engine built for the Noriega Brothers.

This hoist is very similar to the one just described, being driven by Duplex Slide Valve Engines, with cylinders 14 in. by 24 in., and operated in practically the same manner. It differs, however, in that it is provided with two pairs of driving gears instead of one, and also has a center bearing.

Each reel is 42 in. in diameter at the center and will hold 1300 feet of 3 in. by ⅜ in. flat rope.

This hoist will raise a total load of 6800 lbs. from a depth of 1300 ft. at a speed of about 500 ft. per minute.

Plate No. 1064.



Double Reel, Double Geared, Hoisting Engine.

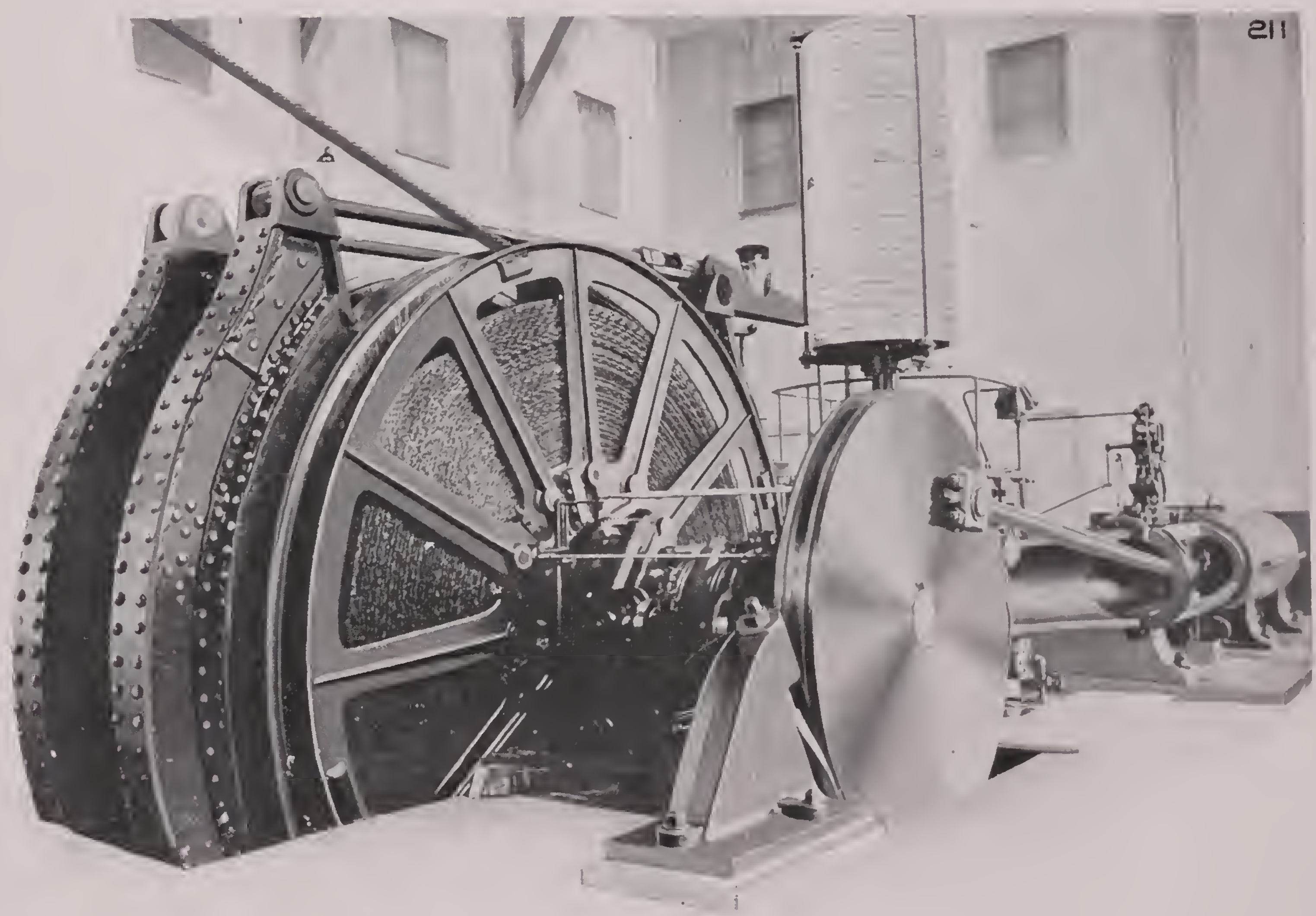
DIRECT ACTING DOUBLE REEL HOISTING ENGINE.

The photograph of the hoist shown by Plate 1065 was taken when the hoist was erected at the mine, and shows the reel wound nearly full.

This engine was built for the Bi-Metallic Mine and is equipped with unusually strong post brakes and crank brakes, as can be plainly seen from the illustration. The hoist is operated from a raised platform and spiral indicators show the position of the cages. The engine is direct acting and is driven by Duplex 22 in. by 60 in. Piston Valve Cylinders. Brakes, clutches, and reversing links are steam operated. The reels are 6 ft. in diameter at their centers and will each hold 3000 feet of 6 in. by ½ in. flat rope. Overwinding is prevented by an automatic safety stop.

This hoisting engine will raise a total load of 22000 lbs. from a depth of 3000 ft. at a speed of 2000 ft. per minute.

Plate No. 1065.



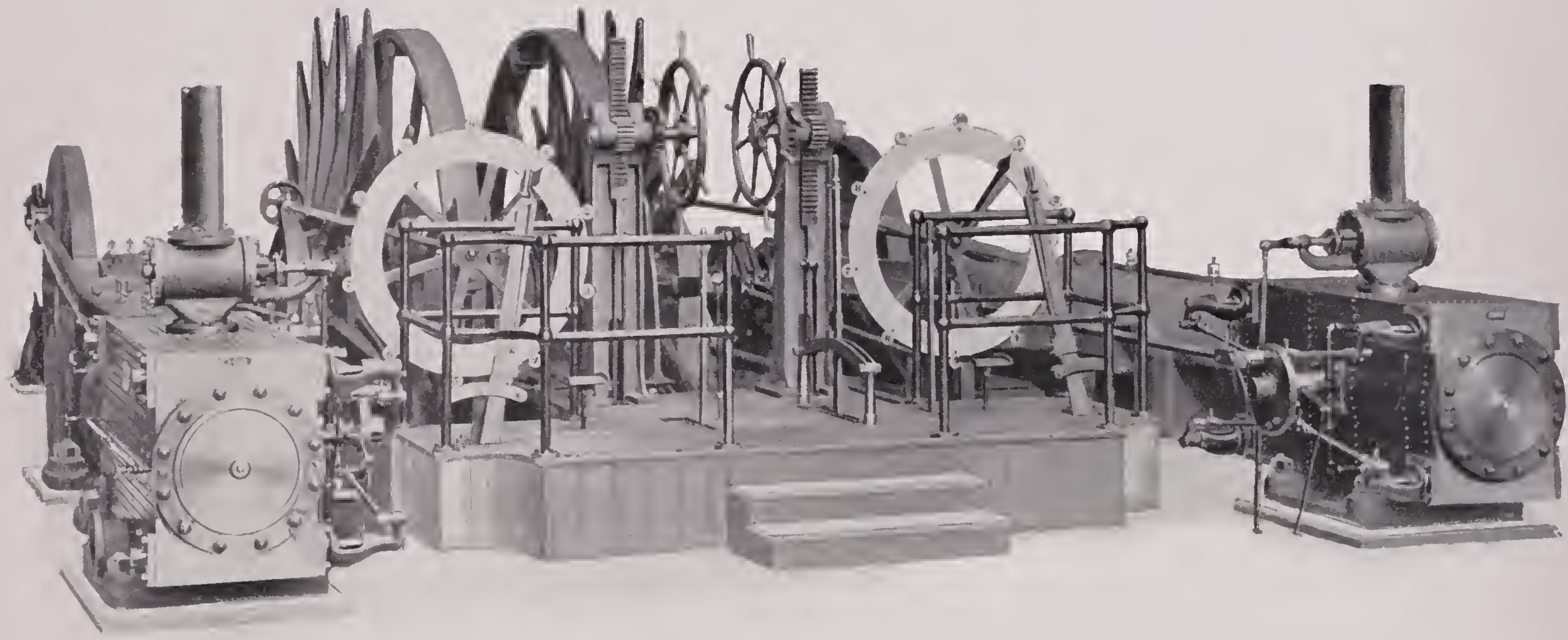
Direct Acting, Double Reel, Hoisting Engine.

DOUBLE REEL, DIRECT ACTING HOISTING ENGINE.

Plates 1059 and 1060 illustrate the Double Reel, Direct Acting Hoisting Engine built by us for the Homestake Mining Company. It is hand operated throughout, the control being from a slightly raised platform and has duplex Corliss cylinders 20 inches in diameter and of 60 inches stroke.

The diameter of the reels at their centers is 5 feet and each will hold 1500 feet of 5½ by ½ in. flat rope.

Plate No. 1059.



Double Reel, Direct Acting Hoisting Engine.

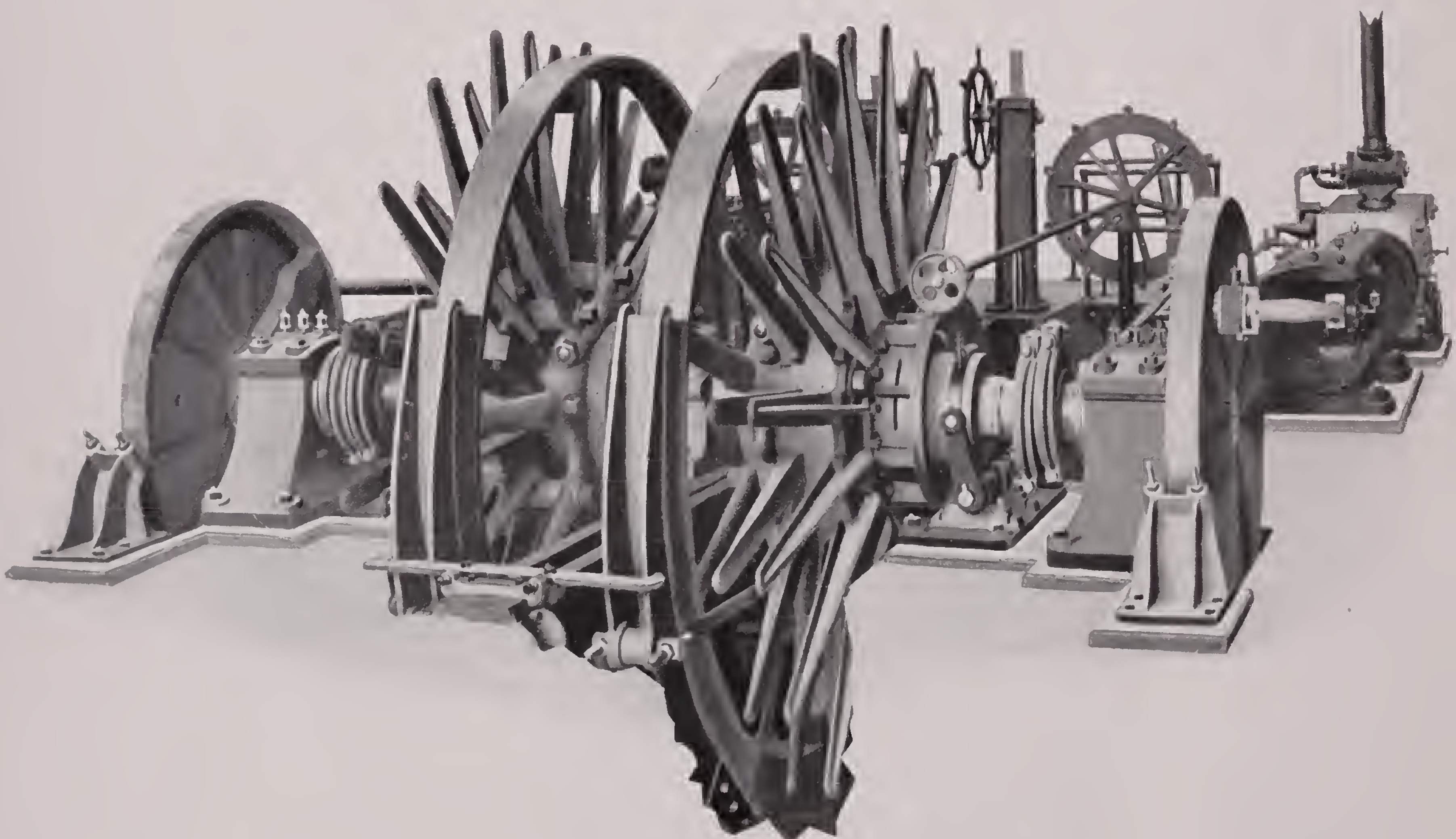
DOUBLE REEL, DIRECT ACTING HOISTING ENGINE.

Plate 1060 is a view of the crank end of the hoist described on the preceding page, and shows clearly the clutch and brake mechanism.

The clutches are of the jaw type mounted on an octagonal shaft. The use of feathers on the shaft for this style of clutch, although quite common, is not to be preferred as the strain and concussion when "clutching in" is very severe.

The cut also shows the worm gear indicator drive. It will be obvious that this drive is direct and positive and fully complies with the law enacted in some states regarding such devices.

Plate No. 1060.



Double Reel, Direct Acting Hoisting Engine.

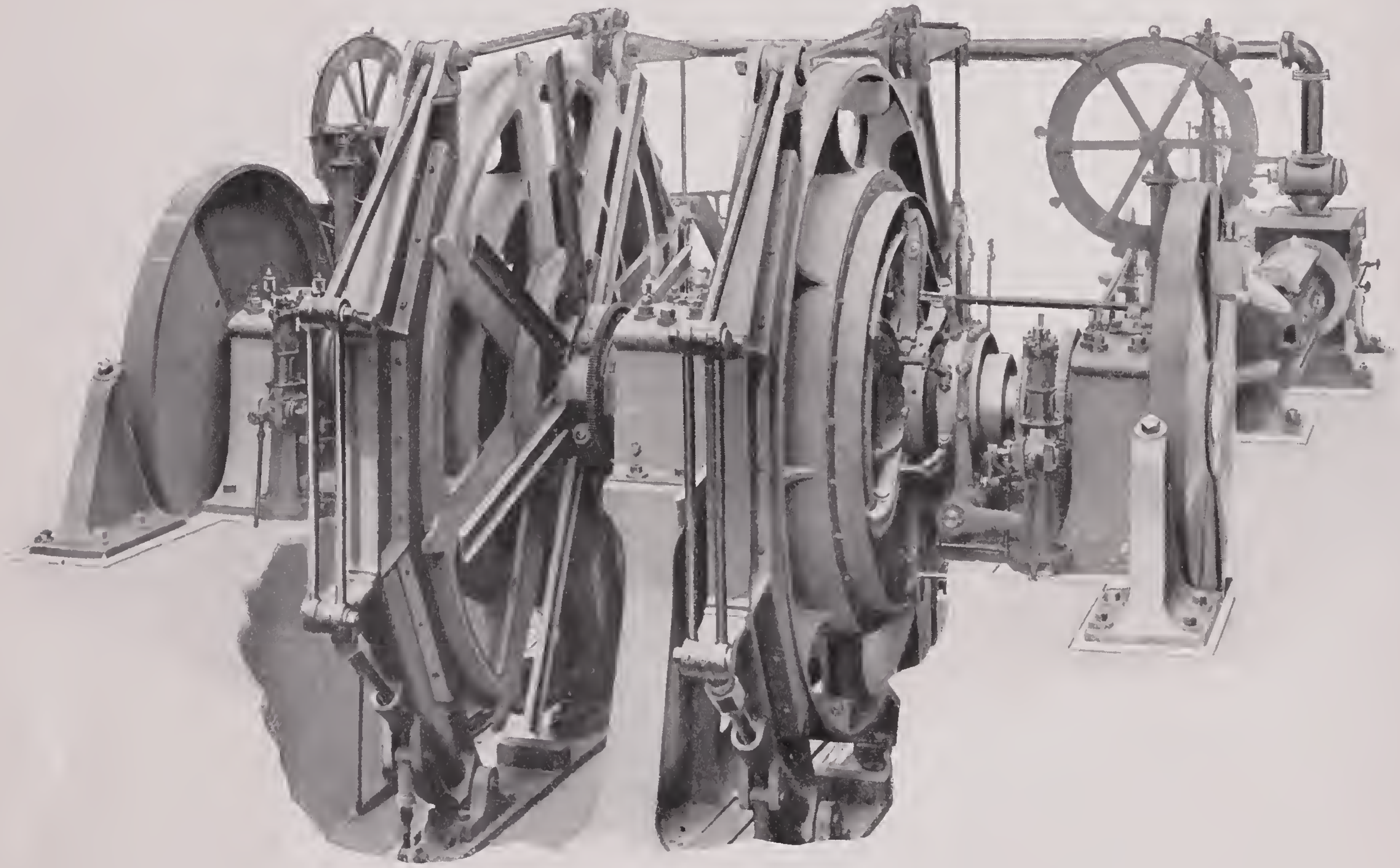
DUPLEX, DIRECT ACTING, DOUBLE REEL HOISTING ENGINE.

Plate 1061 shows the chrank end of a Duplex, Direct Acting, Double Reel Hoisting Engine built for the Centennial-Eureka Mining Company.

The cylinders are 20 inches in diameter by 60 inches stroke and have link motion reversing gear of the Stephenson type. The reels are 5 feet in diameter at the center and each is capable of winding 2500 feet of 5 in. by 3/8 in. flat rope. They are driven by friction clutches, and an automatic safety stop prevents overwinding.

The clutches, brakes and reversing gear are steam operated; the levers for this, together with those operating the crank brakes and throttle valve, being on the engineer's platform.

Plate No 1061.



Duplex, Direct Acting, Double Reel Hoisting Engine.

DIRECT ACTING, DOUBLE REEL CORLISS HOISTING ENGINE.

Plate 745 illustrates an Allis-Chalmers Duplex Corliss Engine, with cylinders 20 in. diameter, stroke 60 in. direct connected to a pair of reels 5 feet in diameter at their centers for winding 2000 feet of 4 in. by ½ in. rope. The reels are fitted with steam operated clutches and post brakes, and the engines have a steam reverse gear. All auxiliary steam cylinders have oil cataract cylinders arranged tandem with the steam cylinders to give an easy and steady motion. A large and heavy pillow block is provided for the center bearing of the crank shaft. This pillow block is of the same design and has the same provision made for taking up the wear that the engine pillow blocks have.

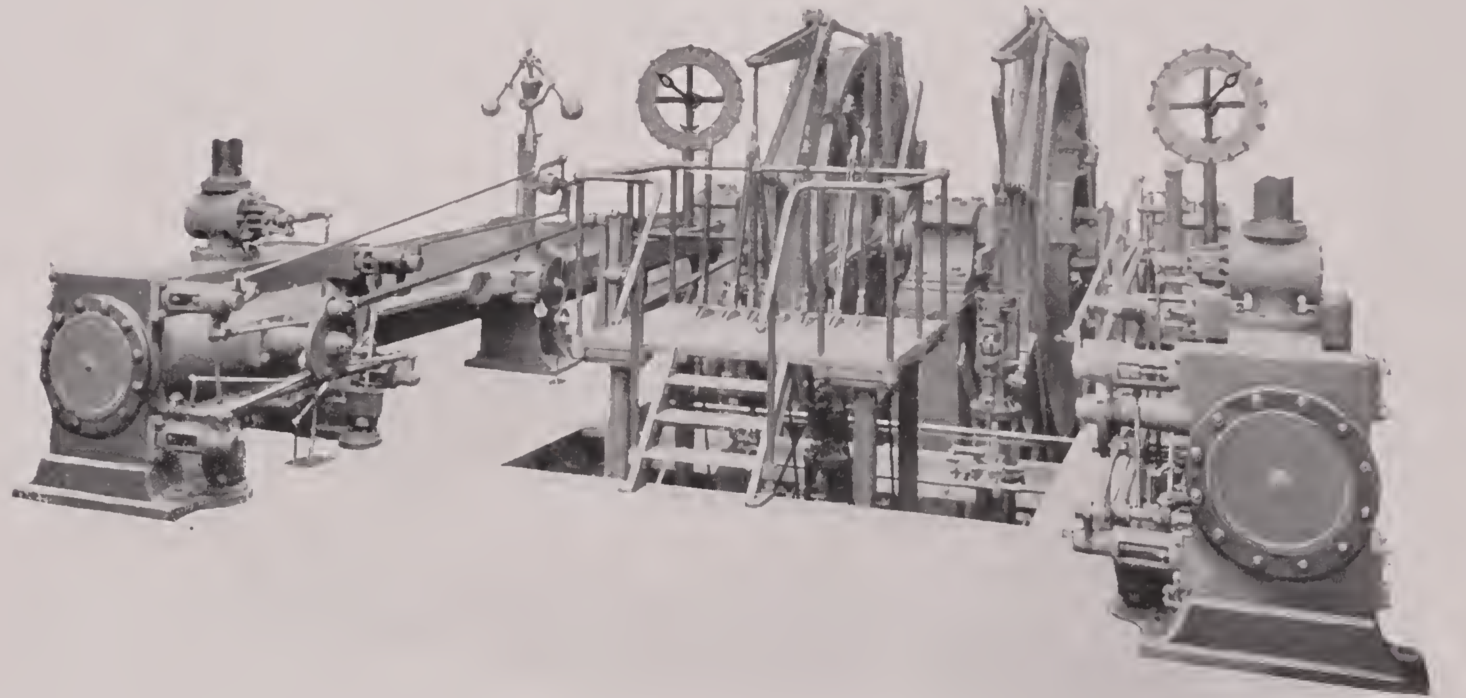
The engraving was made from a photograph taken of a hoisting engine built by us for The Helena-Frisco Mining Company, Idaho.

Since this engine has been in operation we have received orders for duplicates from the Standard Mining Co. and the Consolidated Tiger & Poorman Mining Company. All of these companies are in the same district, and the later orders were due to the eminently satisfactory operation of The Helena-Frisco Co.'s hoisting engine.

We have recently installed two hoisting engines of practically the same design as this hoist but with 20 in. diameter by 48 in. stroke steam cylinders.

One of these hoists is at the Copper Queen Consolidated Mining Co., the other at the Redboy Consolidated Gold Mines.

Plate No. 745.



Direct Acting, Double Reel, Corliss Hoisting Engine.

DUPLEX, TANDEM, COMPOUND CORLISS HOISTING ENGINE.

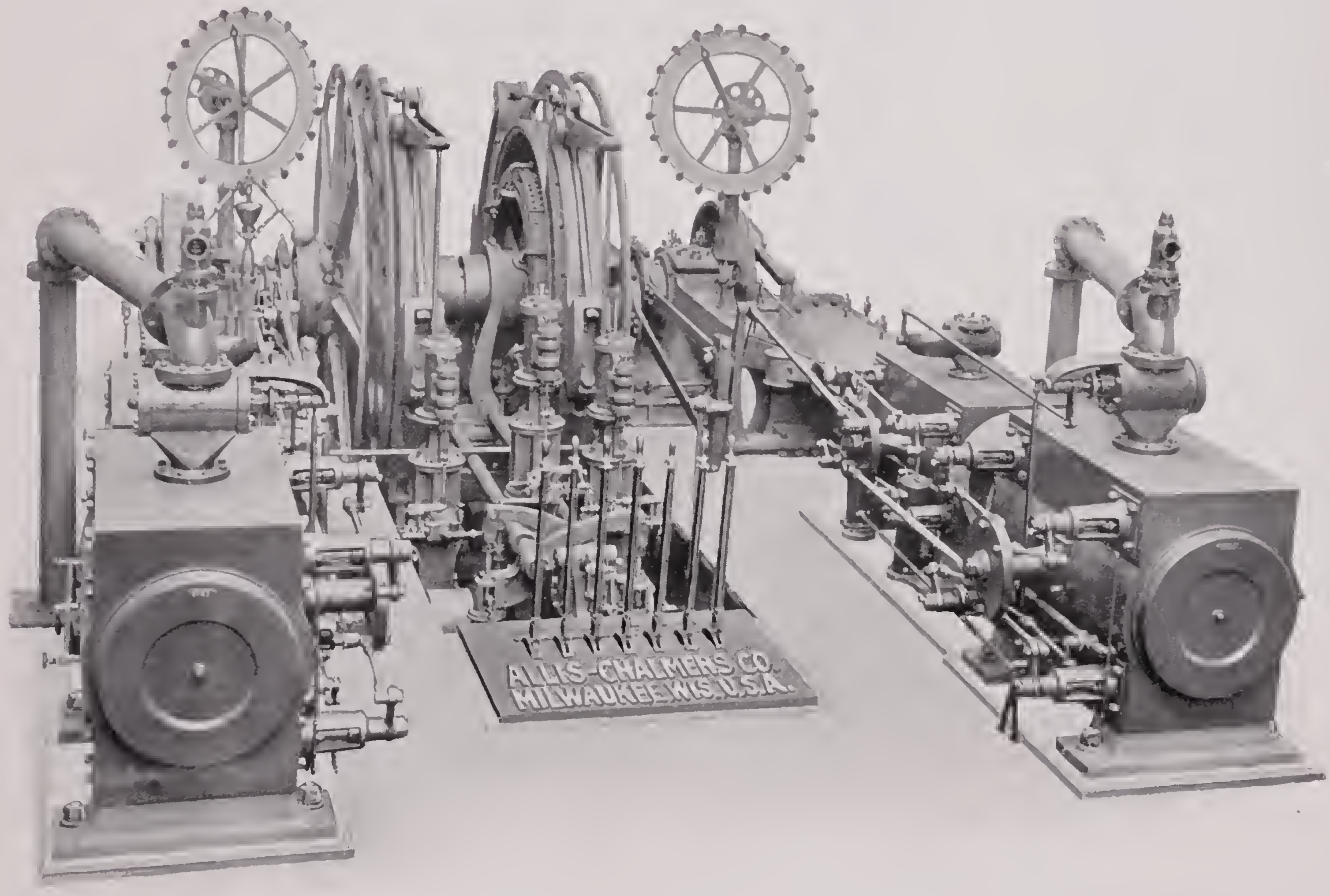
Plates 804 and 1055 illustrate an arrangement of Duplex Tandem Compound Corliss Engines directly connected to a reel shaft. The cylinders of the engine are 16 inches diameter for the high pressure and 24 inches for the low pressure, and the stroke is 42 inches. Arrangement is made whereby high pressure steam can be by-passed into the low pressure cylinders when starting the load. The high pressure cylinders are fitted with Corliss automatic cut-off valve gear under control of a governor and the low pressure cylinders are fitted with Corliss valves having fixed cut-off. Each cylinder has a separate throttle valve, all of which are simultaneously operated by a steam cylinder controlled from the engineer's platform.

The reels are 4 ft. in diameter at their centers and are suitable for holding 2700 feet of 5 in. by 3/8 in. flat rope each. They are fitted with band friction clutches and post brakes, operated by steam cylinders. The reversing gear, which is of the Stephenson type, is also operated by a steam cylinder.

Particular attention is called to the indicators. These, by means of a compensating arrangement, are so constructed as to move the hands at a speed proportionate with that of the rope. This very materially lessens the liability to overwind.

Hoisting engines of this type are particularly recommended for use in localities

Plate No. 804



Duplex, Tandem, Compound Corliss Hoisting Engine.—Cylinder End.

where fuel is expensive and the duty is continuous. Experienced mining men who have made the subject of hoisting a study, are also adopting them for use at mines where fuel costs only from $2.00 to $2.50 per ton.

This engine is able to handle the load unbalanced, starting from any level and with the cranks in any position, while the automatic cut-off of the steam by the governor enables the engine to work economically when hoisting in balance.

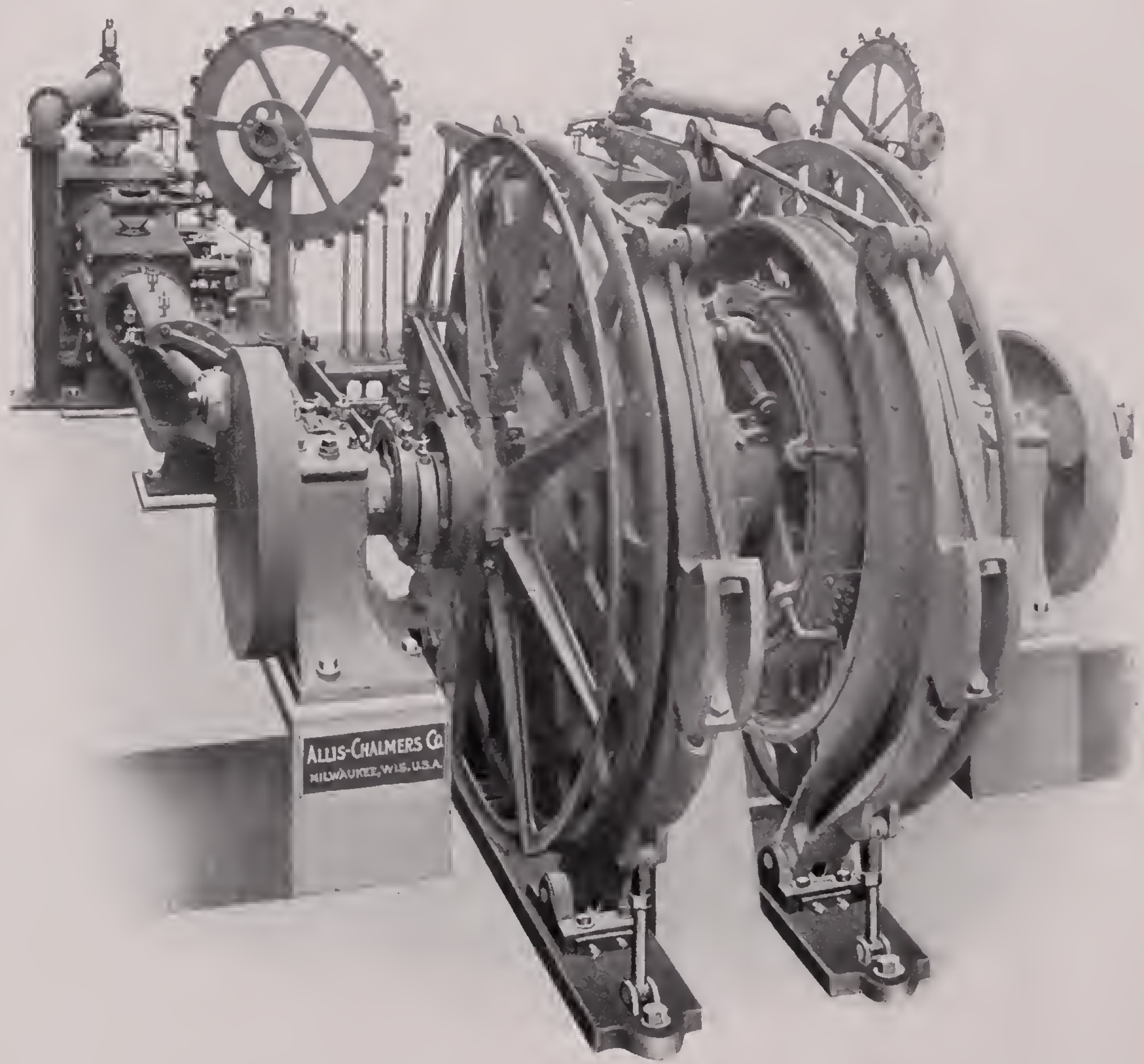
By referring to Plate 804, it will be seen that the operating levers are very conveniently located on the engineer's platform on the floor level, enabling the engineer to control all operations without moving from his position.

The economical advantages of compound hoisting engines are best obtained where there is continuity of operation.

Plate 1055 is a view of the crank end of the Duplex, Tandem Compound Corliss Hoisting Engine and shows more clearly the compensating device attached to the indicators and also the details of the reels, band friction clutches, post brakes, etc.

The engravings were made from photographs taken in our shops of a hoisting engine built for the Grand Central Mining Co., Mexico. A duplicate of this engine was also built by us for the Chihuahua Mining Co., Mexico. We especially recommend the Duplex, Tandem Compound Engine in preference to the cross-compound type, when the load is variable, as it starts more easily.

Plate No. 1055.



Duplex, Tandem Compound, Corliss Hoisting Engine.—Crank End.

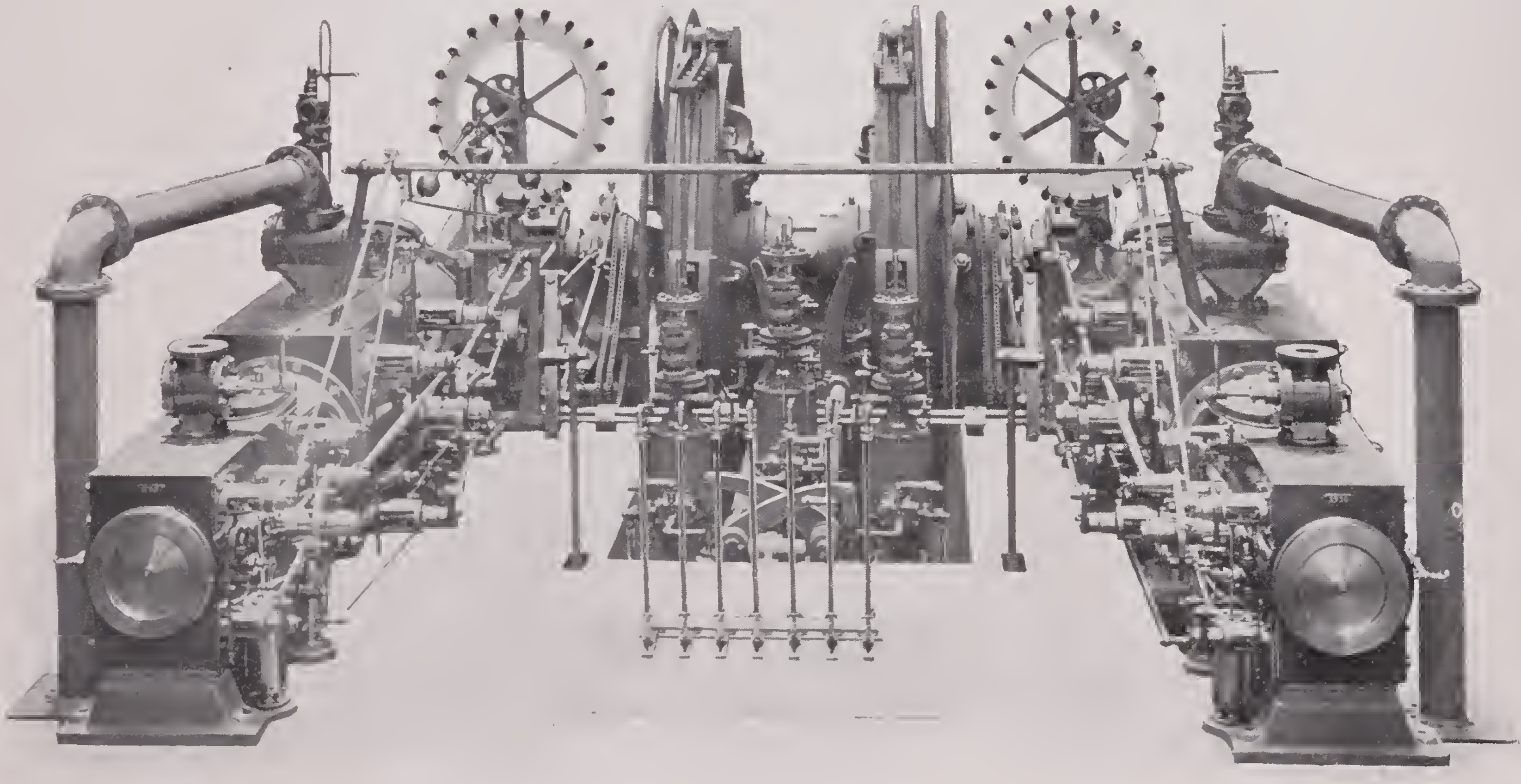
DUPLEX, TANDEM COMPOUND HOISTING ENGINE.

Plate No. 744 illustrates a Duplex, Tandem Compound Corliss Hoisting Engine, having high pressure cylinders 14 inches in diameter and low pressure cylinders 22 in. in diameter by 42 in. stroke. The reels are each of sufficient size for winding 2700 feet of 4 in. by ⅜ in. flat rope. They are fitted with band friction clutches and post brakes of our standard designs. An automatic safety stop is connected to the reels to prevent over-winding. The hoist is operated by steam throughout, the auxiliary steam cylinders being in turn operated by hand levers on the engineer's platform.

The engraving was made from a photograph taken of a hoisting engine built by us for the Negociacion de Santa Ana, Mexico.

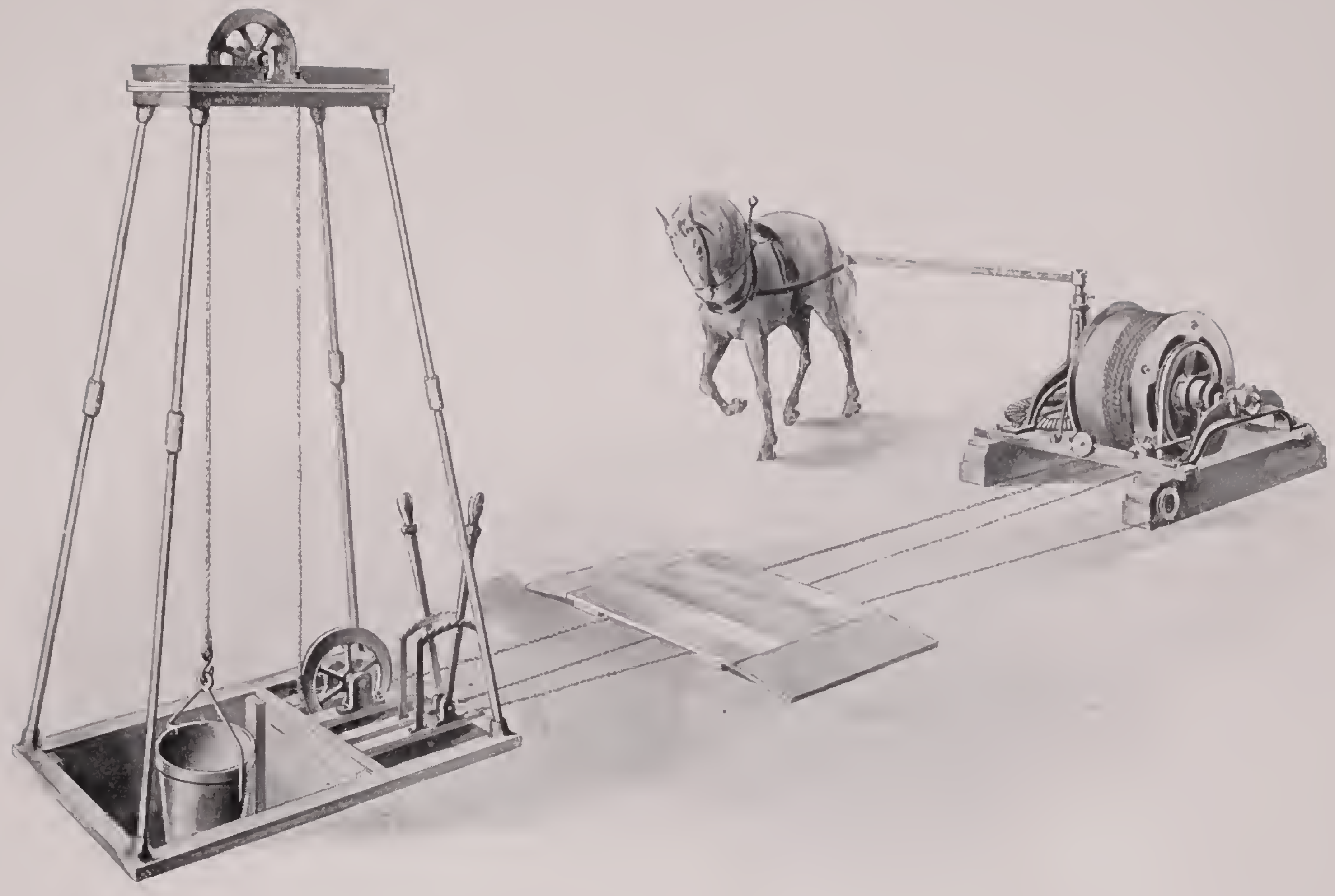
The prestige gained by many years of experience in building mining machinery together with our unequalled manufacturing facilities is reflected in the character of our productions. The firm name of Allis-Chalmers Co. is closely identified with all the more important advances that have been made in perfecting mining machinery and all the auxiliary appliances for treating ores.

Plate No. 744.



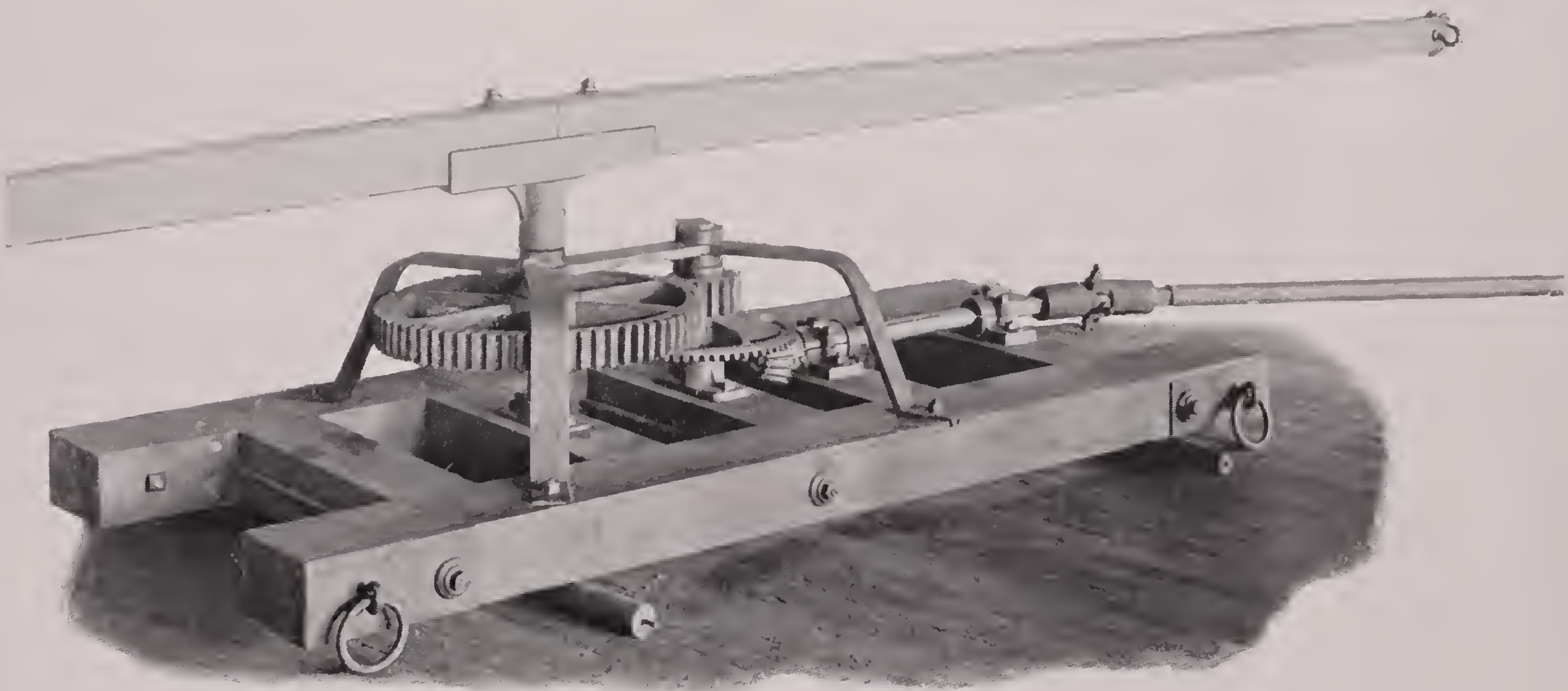
Duplex, Tandem Compound Hoisting Engine.—With Corliss Valve Gear.

Plate No. 126.



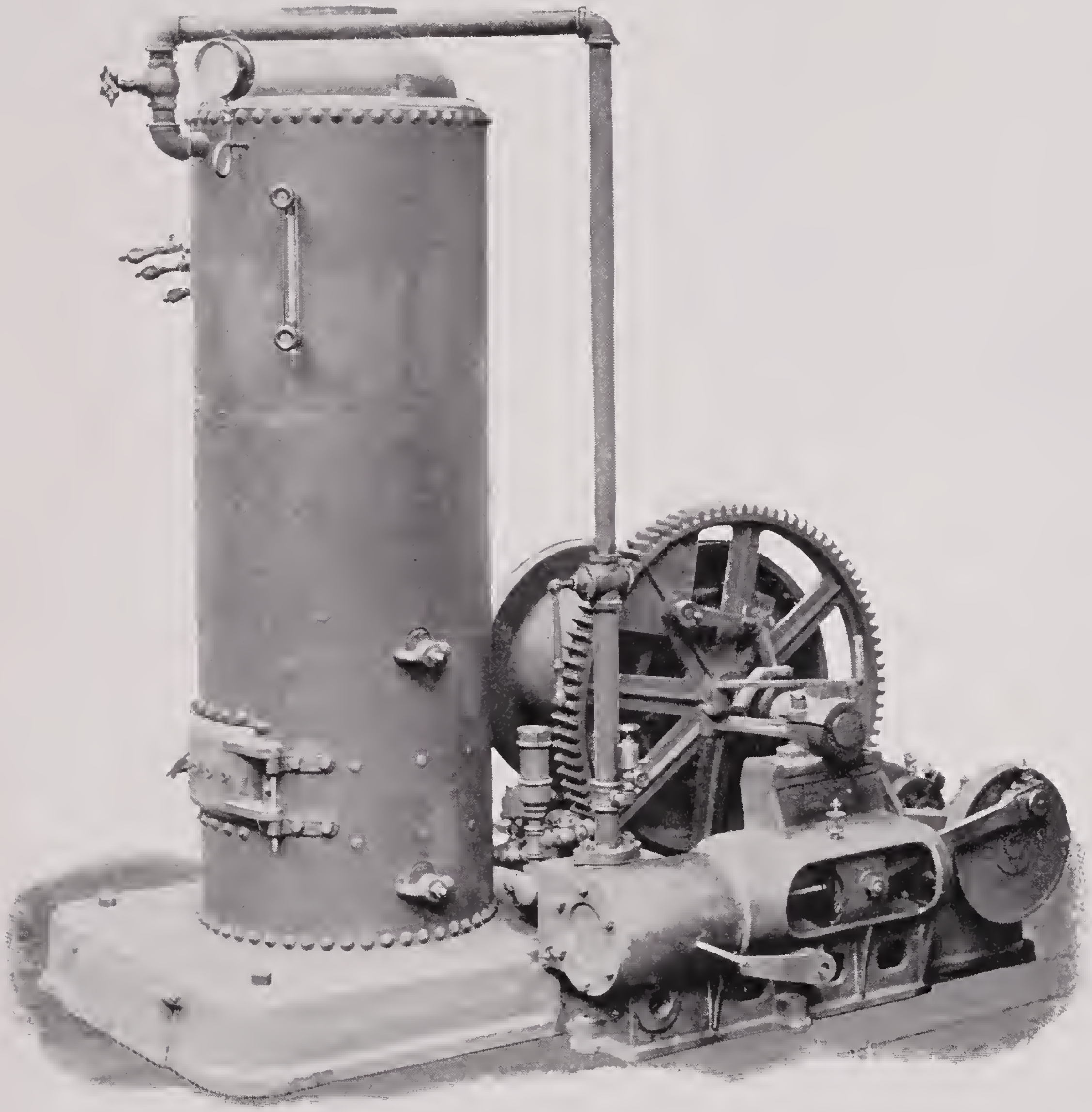
Horse Power Hoist or Whim.—Weight, Including Overhead Sheaves, 2,400 lbs.
With horse walking will lift 400 lbs 60 feet per minute. With light rope and bucket will lift from depth of 300 feet. Gallows frame sectionalized to 250-lb parts.

Plate No. 131.



Double Sweep Horse Power Hoister.—Weight 1,500 Lbs.
One Revolution of the Sweep Gives 15 Revolutions of the Shaft.

Plate No. 566



Portable Hoisting Engine with Boiler and Feed Pump.

SINGLE CYLINDER PORTABLE HOISTING ENGINE.

With Boiler and Feed Pump.

Plate 566 illustrates a machine particularly well adapted for prospecting for small mines, coal yards, ore docks, and such places where a complete, self-contained hoisting plant is required. It is substantially built and well arranged. A continuous bed-plate carries the engine and boiler. The drum is fitted with a band friction clutch operated by a hand lever, and a band brake operated by a foot-lever. The bands are lined with wooden blocks, provision being made for taking up wear. Throttle, clutch and brake levers are all within easy reach of the operator.

A heavy fly wheel is placed on the outer end of the crank shaft and may be used to drive other machines. The boiler shell is made of flange steel throughout and the boiler is fed by a single acting pump, driven by an eccentric on the engine shaft. The hoist operates economically and requires no special foundation.

STANDARD SIZES.

Code word	Agitable	Agitabunt	Agitacao
Number	No. 0C	No. 1C	No. 2C
Diameter of cylinder	6 in.	7 in.	8 in.
Stroke	8 in.	10 in.	10 in.
Diameter of drum	18 in.	20 in.	20 in.
Length of drum	18 in.	20 in.	20 in.
Diameter of rope	½ in.	⅝ in.	⅝ in.
Feet rope in one coil	150	165	165
Revolutions per minute	260	250	240
Horse power	12	18	22
Gears { No. teeth in gear	89	89	89
Gears { " " " "	20	20	20
Approximate hoist speed	275	300	286
Max. load	1,200 lbs.	1,800 lbs.	2,350 lbs.
Height of boiler	5 ft.	7 ft.	7 ft.
Diameter of boiler	30 in.	30 in.	36 in.
Weight complete	4,700 lbs.	7,000 lbs.	8,500 lbs.

CAGES.

SAFETY HOISTING CAGE.

Our cages are very carefully and strongly constructed throughout of the best Swedish iron and steel. They are fitted with safety catches worked by either coil or carriage springs, as desired, preventing the possibility of the cage falling should the rope break. These catches are held away from the guides while the weight of the cage hangs on the rope, but are released and spring against the guides immediately when the strain is taken from the rope. The uprights each have a slot through which to tighten the bolts or screws in the guide timbers.

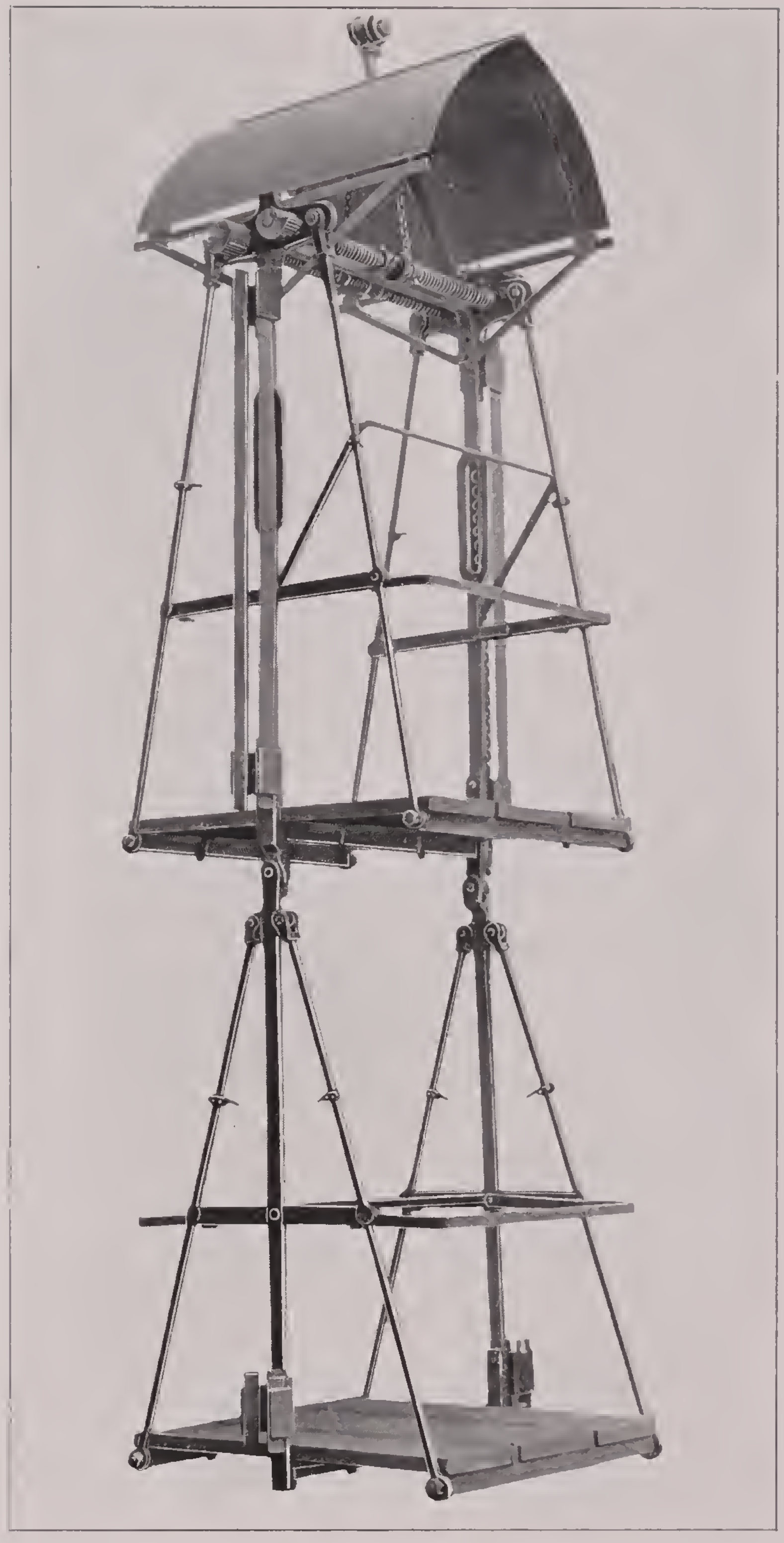
The platform is planked over and has a track built in, so that cars may be easily run off or on. A sheet steel hood or shield is attached to the top to prevent the men from being injured by anything falling down the shaft, the hood being hinged to open from the center to permit carrying long mine timbers on end.

When ordering give exact size of the shaft in the clear, and the gauge of the car track if already laid, and also the size of the guides.

Plate No. 766.

Safety Hoisting Cage.

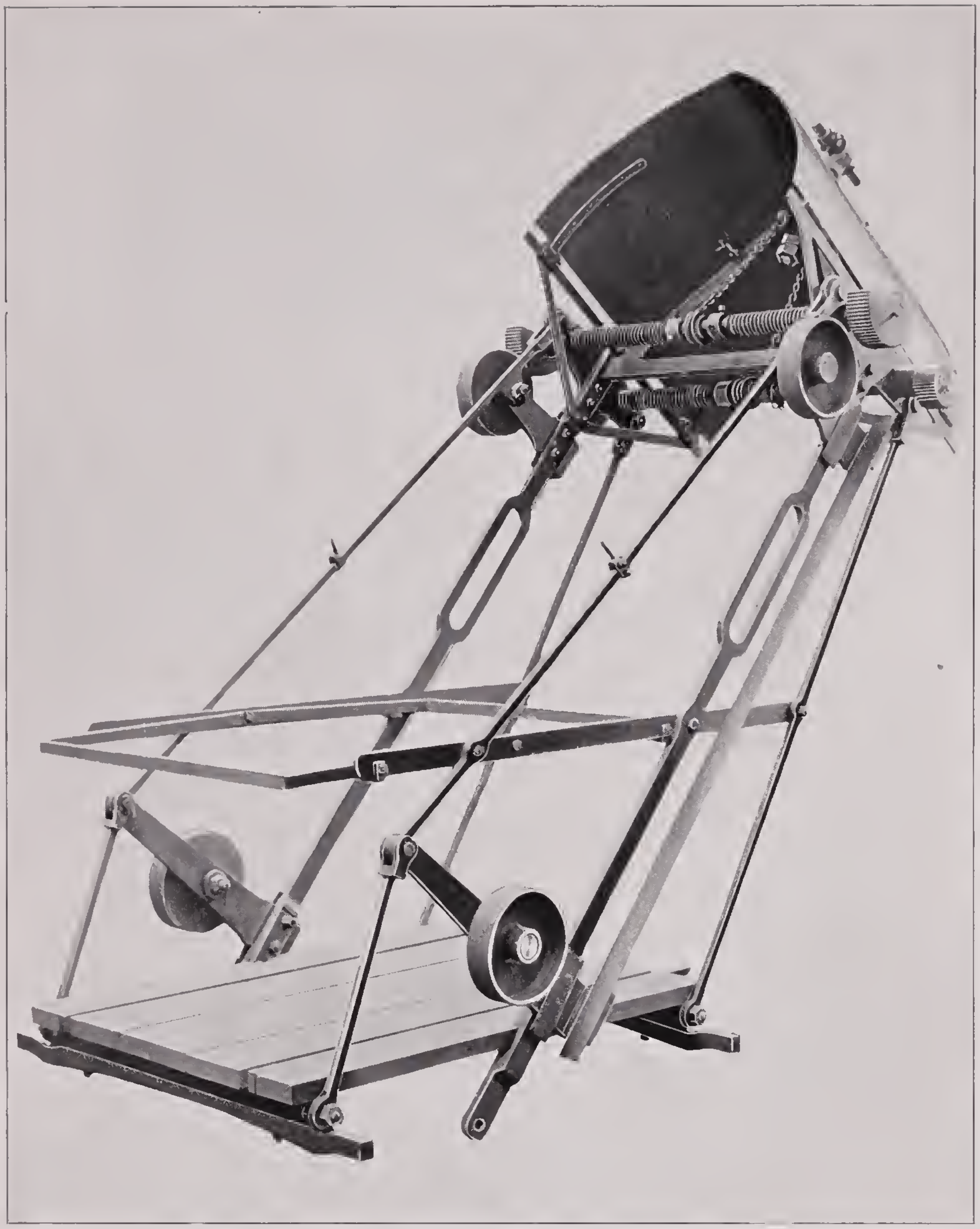
Plate No. 742



DOUBLE DECK SAFETY HOISTING CAGE.

Plate No. 742 represents our Double Deck Cage. The upper deck or platform is constructed in every way like the single deck cage, but is heavier. The lower deck is suspended from the upper part of cage by pins so as to be easily removed at any time.

Plate No. 743.



HOISTING CAGE FOR INCLINED SHAFTS.

Plate 743 shows our Standard Hoisting Cage for inclined shafts. When required, we construct this cage with an adjustable platform to fit shafts of various angles. The platform in such case is hinged on levers and can be adjusted by a hand lever to a level position.

Cages can be made of any desired size and to suit any angle.

In ordering, or when requesting quotations, correspondents should give the exact size of the shaft in the clear and the correct angle of the shaft from the *horizontal*, and also the gauge of the car track.

Plate No. 1093.

HOISTING CAGE.

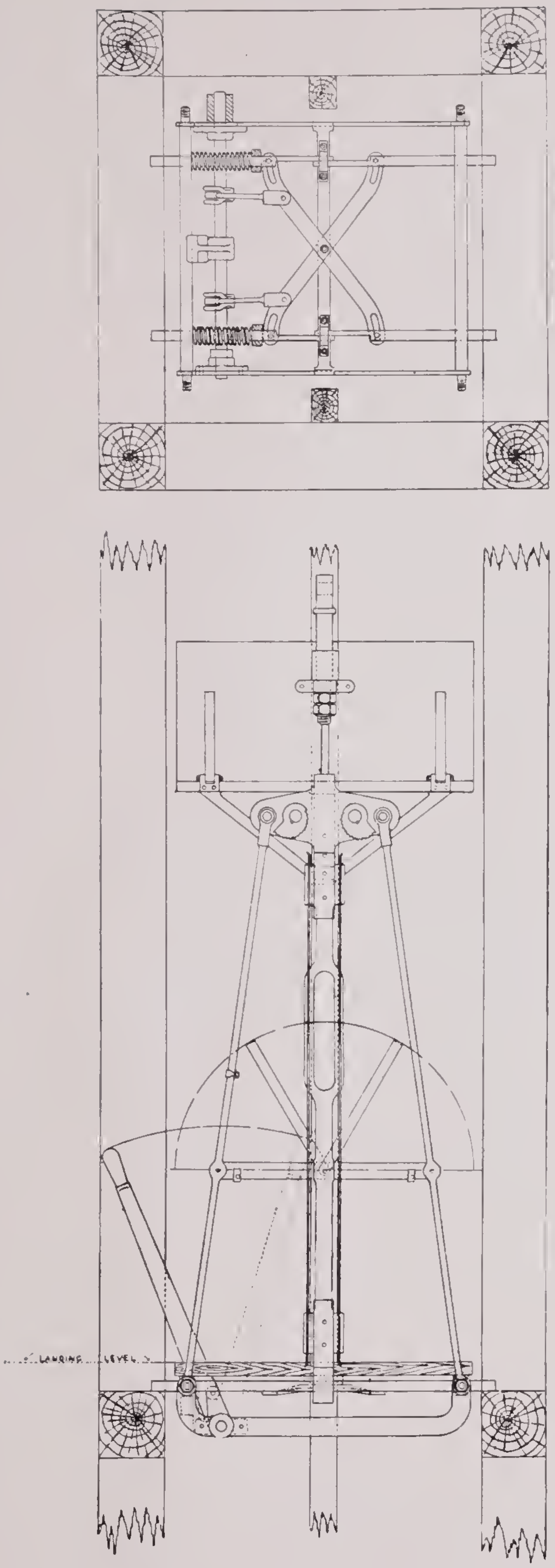
WITH EXTENSION FOR USE IN SINKING SHAFT.

When sinking a vertical shaft, the timbers cannot be carried clear down to the bottom, hence it is usual to have a bucket which can be lowered to a convenient point for loading.

The cut on this page shows a method of extending the guides of the cage so that the cage may be lowered below the guide timbers far enough to be readily loaded. This extension is so constructed that it will run up beyond the sheave, as the rope is attached to the cage proper. This arrangement does not necessitate a special elevation of the sheave. The extension is heavy and its weight must not be overlooked when providing a hoisting engine and in choosing the size for rope.

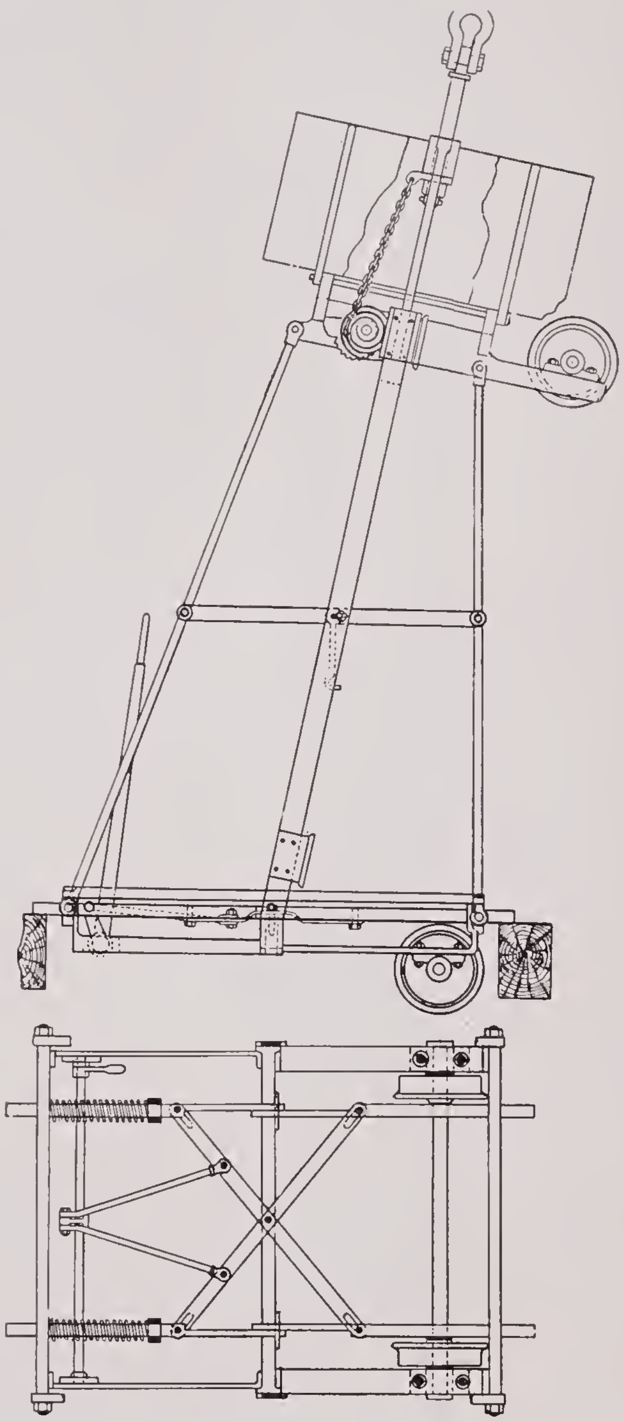
When the sinking is completed, the extension can be removed, leaving an ordinary cage.

Plate No. 814.



For Vertical Shafts.

Plate No. 372.



For Inclined Shafts.

Gray's Patent Cage Chairs.

GRAY'S CAGE CHAIRS.

Gray's Patent Cage Chairs are an improvement upon the ordinary system of having separate sets of chairs for each shaft level, in that their employment substitutes a single set of chairs carried by the cage in place of a considerable number of chairs, one for each level. This effects a large saving, especially in deep shafts. The Gray Chairs are also conveniently operated either from the cage or from any level of the mine, and have proved in practice to be thoroughly reliable and to satisfy all the requirements of mine shaft chairs.

In Plate 814, the chairs are shown applied to the cage of a vertical shaft.

In Plate 572 they are shown applied to the cage of an inclined shaft.

The method of operation apears clearly from the illustrations.

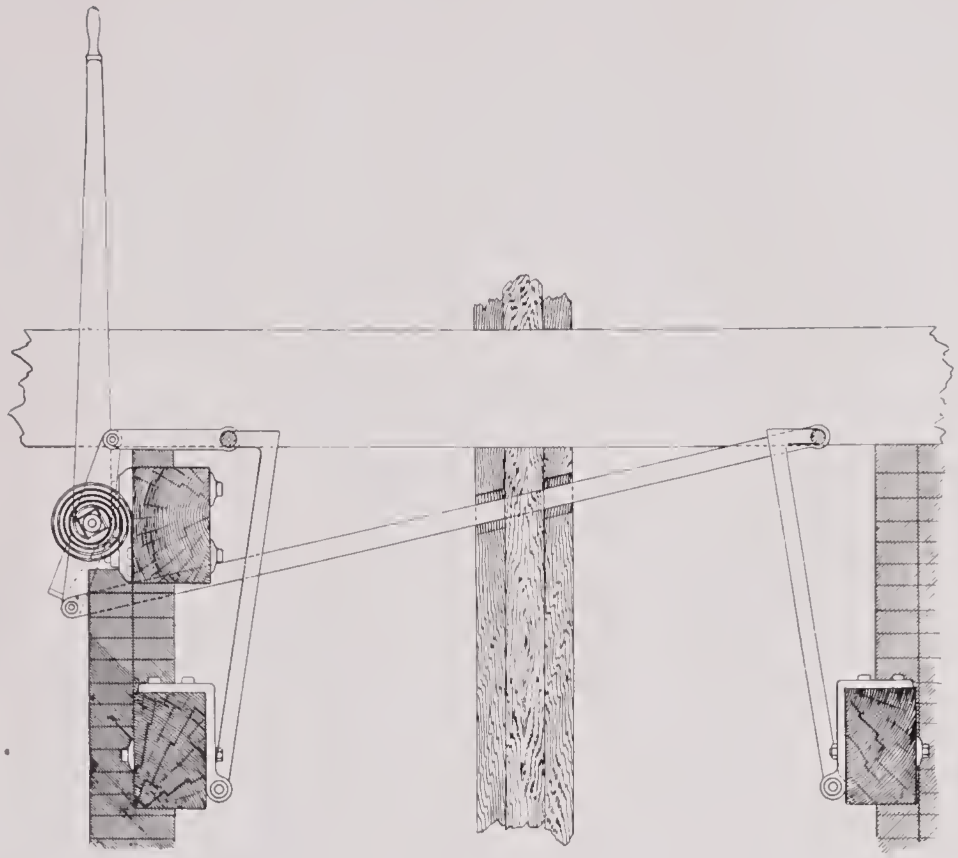
A lever mounted upon the floor framing of the cage when thrown inward or outward causes bars forming an extension chair to slide in or out.

When out, these bars rest in notches or upon wall plates in the shaft. The sliding bars are properly framed together and are cross connected by diagonal bars pivoted under the cage, and having slots connecting with pins in the slides. When the lever is out of operation, springs between the diagonal bars and the cage frame close the diagonals with a retractile action so as to draw the chair slides inwards from, and clear of the wall plates.

This description applying to the particular design shown does not limit the breadth of claims of the patent. In the case of vertical shafts with levels opening on opposite sides, the Gray Chairs are constructed with two levers, either of which will operate them, so that they may be handled from either side of any level. The minor features of the essential designs are thus adaptable to the mine shaft upon which it is to be used, and we recommend the equipment of cages in use, as well as new shafts, with these chairs as a useful measure of economy and for greater safety. Gray's Patent Chairs are used in the shafts of Hope Mine, Leiter Mine and other mining properties, and have received the endorsement of many practical mining men.

The price depends on the size of shaft and will be quoted promptly on application, giving necessary dimensions.

Plate No. 1092.



LANDING DOGS.

Landing Dogs, or Chairs, unless they are built as part of the cage itself, are provided at the tops of shafts and at every level at which a cage is required to stop.

The cut above shows landing dogs of the usual form. The hand lever can be reached and operated from the cage platform if necessary.

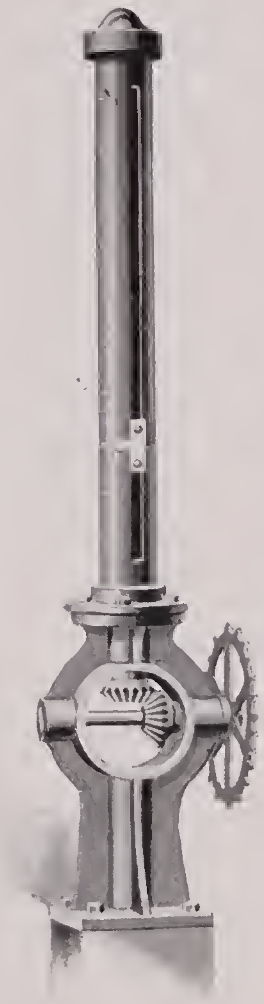
These dogs are built to suit any size of shaft. Our design is simple, convenient and exceedingly strong.

INDICATORS.

COLUMN INDICATOR.

Plate 1089 shows our Column Indicator which is also well adapted to parallel drum hoists. The location of the cage is indicated by a pointer moved in accord with the movement of the cage. This indicator may also be driven by a link belt or by gearing from the drum.

Plate No. 1089.



Column Indicator.

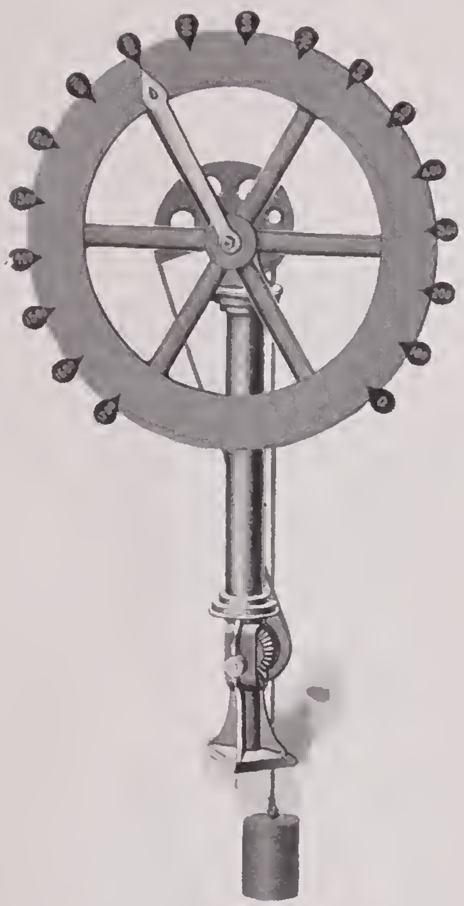
Plate No. 1086.

Dial Indicator.

DIAL INDICATOR.

Plate 1086 shows our Dial Indicator particularly adapted to drum hoists where the length of rope wound on the drum is constant for each revolution. This indicator may be driven either by a link belt from a sprocket wheel on the drum, or by gearing from the drum.

Plate No. 1090.



Front View.

Plate No. 1091.

Back View.

COMPENSATING DIAL INDICATOR.

Plates 1090 and 1091 are respectively front and back views of our Dial Indicator fitted with a Compensating Device. This indicator is especially valuable when used on Reel or Conical Drum Hoists, for by means of the Compensating device the hands are moved at a speed proportionate with that of the rope. The speed varies as the rope winds or unwinds on the reel.

Prices quoted upon application.

SKIPS.

SELF-DUMPING SKIP FOR VERTICAL SHAFT.

The much greater tonnage raised from an inclined shaft by the use of self-dumping skips as compared with ordinary hand loaded and hand unloaded cages, led us to offer the above design for use in vertical shafts. It combines the advantages of automatic dumping possessed by skips as used on inclined shafts, with the safety of the cages for vertical shafts.

This type of skip is being used in the Chapin Iron Mine, the De Beers Diamond Mines, the Alaska Mines and others.

These skips can be made of any capacity and to suit any size of shaft. They may also be provided with hoods in case no other means for carrying men is provided, or they may be suspended under a single deck cage. In the latter case the cage deck would be used for men and timbers and the skip for ore only.

In inquiring for prices give the capacity of the skip and size of shaft. When using these skips a special dumping arrangement is necessary in the gallows frame.

Plate No. 967.

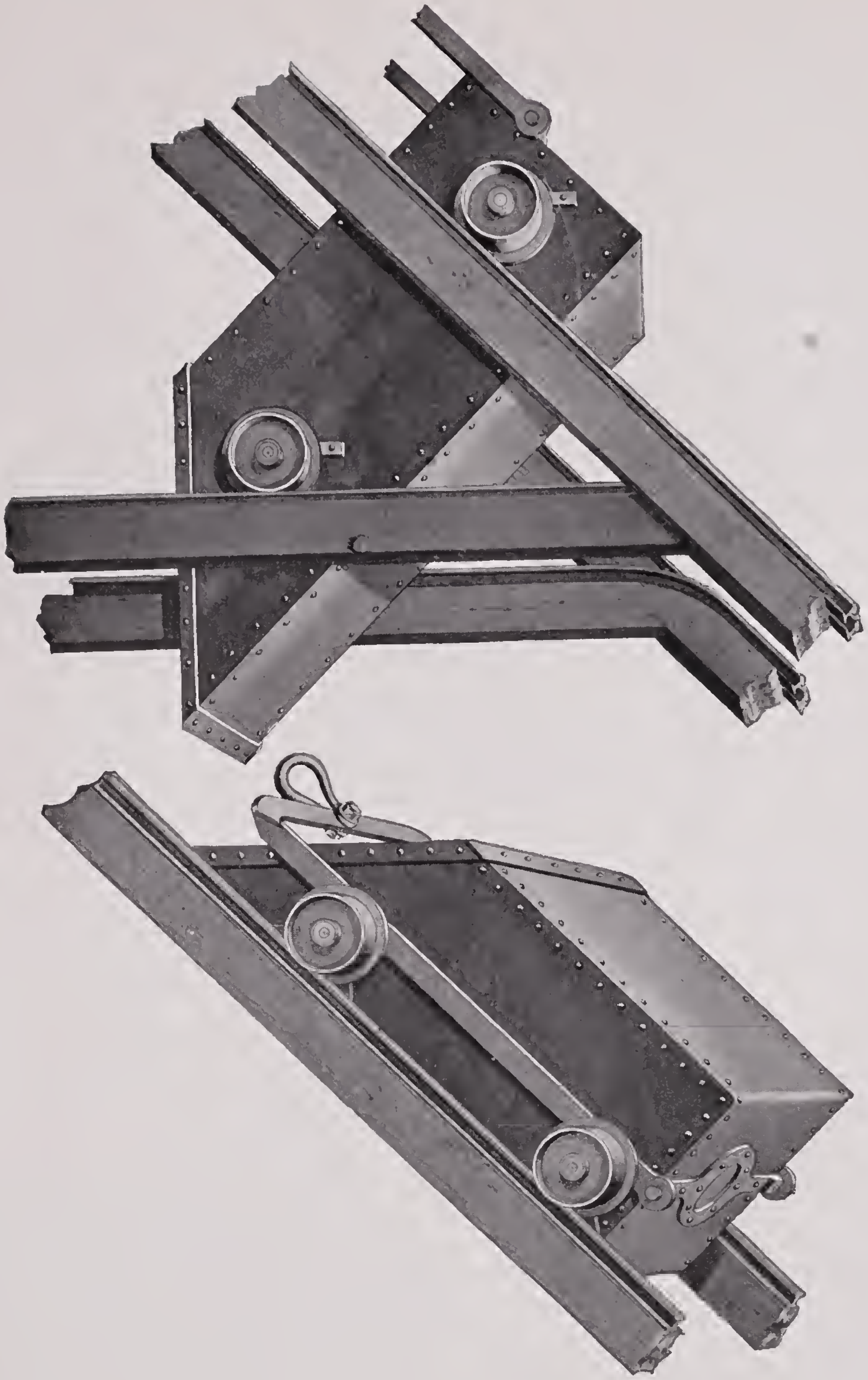
Locked.

Plate No. 968.

Released.

Self-Dumping Skip for Vertical Shaft.

Plate No. 95.



ORE AND WATER SKIP FOR INCLINED SHAFT.

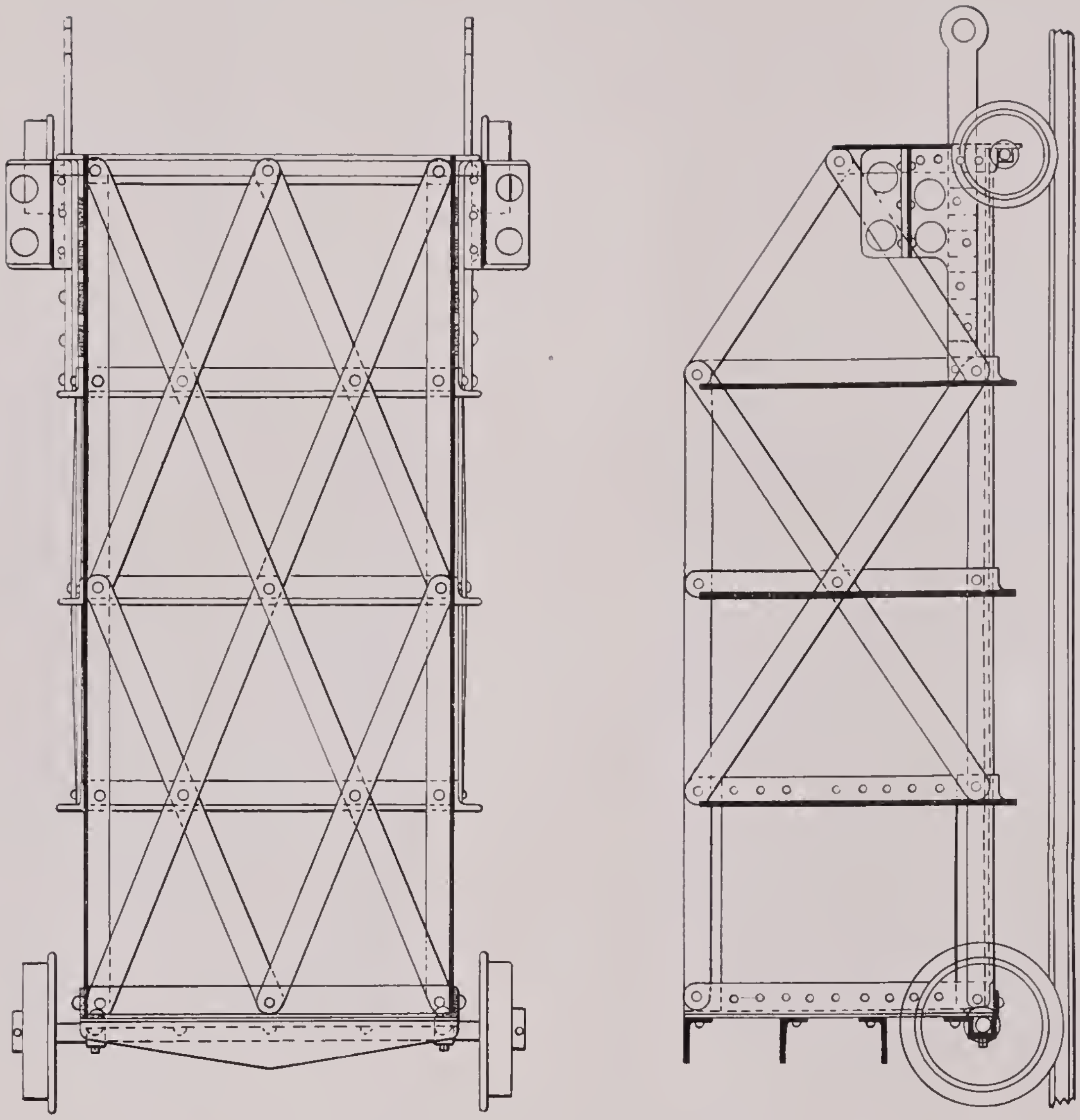
Automatic Self-Dumping.

We build Ore Skips for any angle of inclination, constructed in the best manner of heavy sheet steel and well braced with angle iron. These are designed for automatic dumping with rear wheels of a wider face than the front wheels, which latter pass through an opening at the point arranged for dumping.

Water skips are provided with an automatically opening valve.

When ordering give the exact size of shaft in the clear, and its angle from the horizontal. Prices on application.

Plate No. 2056.



Steel Skeleton Timber Skip.

TIMBER SKIP.

In many mines which work through an inclined shaft or slope the problem of handling timber, ladders, small pumps, rock drills, coal cutters and other tools or materials is often an important factor and the time necessarily consumed in loading and unloading these articles seriously decreases the possible output of the shaft or necessitates the employment of an extra shift of men with its attendant expense, for the sending down of timber. An effective skip for this work is shown in plate No. 2056. The extremely light, yet strong construction of this skip combined with a maximum carrying capacity for the size of the shaft will at once appeal to the practical miner.

This skip is intended to be suspended directly below the regular ore skip by means of wire ropes attached to the ore skip by safety hooks.

We build these skips for any sized shaft and to operate over any incline or slope.

ORE BUCKETS.

Figure 1 shows a tapered side, self-dumping, ore bucket with safety link. This bucket is preferred by some, but owing to its projecting rim and bail, it is not as safe as the bucket shown by Figure 2.

Figure 2 shows a Cornish Kibble arranged to be dumped by hooking to an eye on the bottom of the bucket. The shells of these buckets are $\frac{1}{4}$ inch thick and the bottoms of $\frac{3}{8}$-inch thick steel.

Plate No. 17.

Fig. 1.

Fig. 2.

STANDARD SIZES, FIG. 2.

Code Words	Diameter in Inches.			Height (Inches)	Weight (Pounds)	Capacity (Cubic Ft.)
	Top	Center	Bottom			
Abimeras	16	18	14	26	180	2.5
Abinadab	18	16	16	26	180	2.5
Abinicio	18	20	16	26	200	3.34
Abirato	18	20	16	30	220	4.
Abismaba	21	26	21	36	350	9.
Abirren	21	24	18	30	280	5.5
Abishag	22	24	20	30	290	6.
Abismamos	27	30	24	30	350	10.
Abismales	22	26	22	36	355	9.1
Abismo	24	26	24	32	320	8.5
Abissando	24	26	22	36	348	9.
Abissare	28	30	28	38	470	13.8

The above sizes being frequently ordered, are coded and listed for convenience, but we will build buckets of any specified size, weight and capacity with equal promptness. Prices on application.

WATER BUCKETS.

These buckets have fixed bails and bottom valves. They are made of steel plate in the best manner, and are useful where the volume of water to be raised does not warrant the expense of an independent pumping plant.

Plate No. 164.

STANDARD SIZES.

Code Words.	Diameter in Inches			Depth (Inches)	Finished Weight (Pounds)	Capacity (Gallons)
	Top	Center	Bottom			
Abitudine	18	20	16	30	240	34.
Abituro	20	22	18	32	275	43.5
Abiturum	24	26	21	36	340	74.
Abijachen	24	26	22	36	370	76.
Abjagen	26	30	24	42	470	100.
Abjammern	27	30	25	42	476	118.
Abjeccao	26	29	24	52	535	127.
Abjectly	28	31	26	52	580	142.
Abjectness	33	36	30	54	700	200.

Buckets of any other sizes or capacities, built and furnished with equal promptness. Prices on application.

MINING CARS.

STANDARD SIDE AND END DUMP MINING CAR.

Car sides and ends are No. 10 tank steel, bottom is of ¼-inch steel, door of 3/16 inch steel, unless otherwise specified.

For over-all dimensions, add 6 inches to length and 5 inches to width of body.

Plate No. 730B.

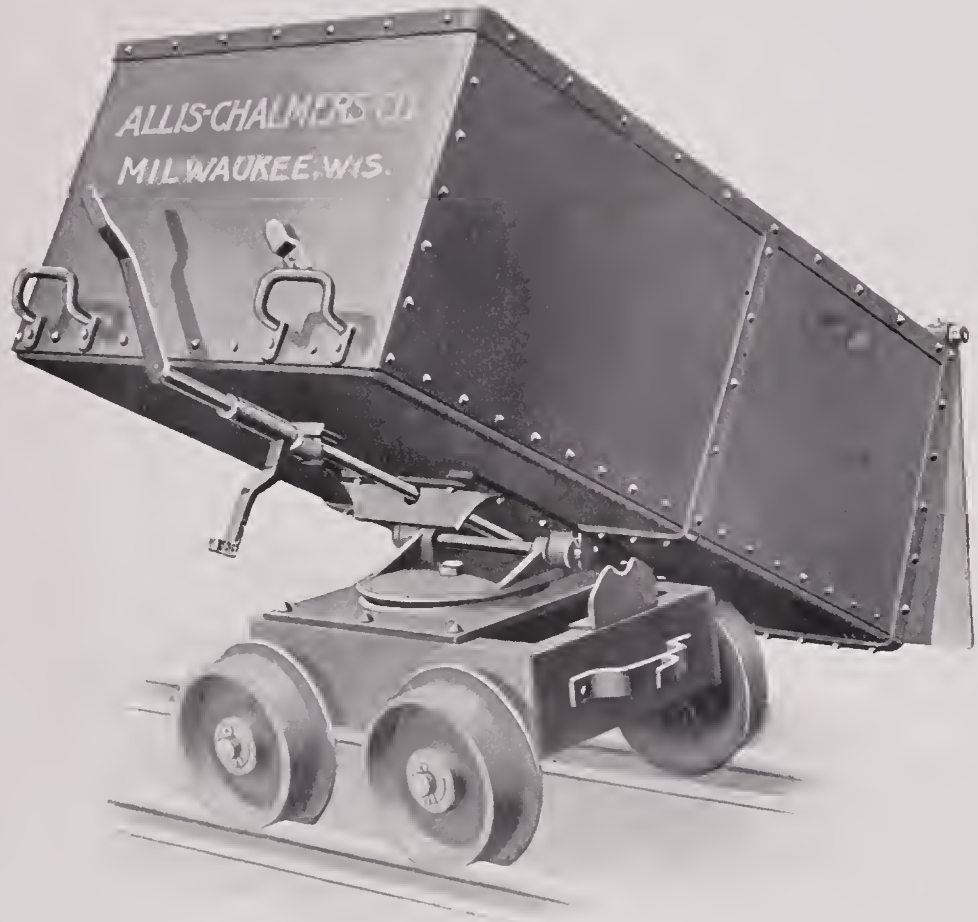


TABLE OF SIZES AND WEIGHTS.

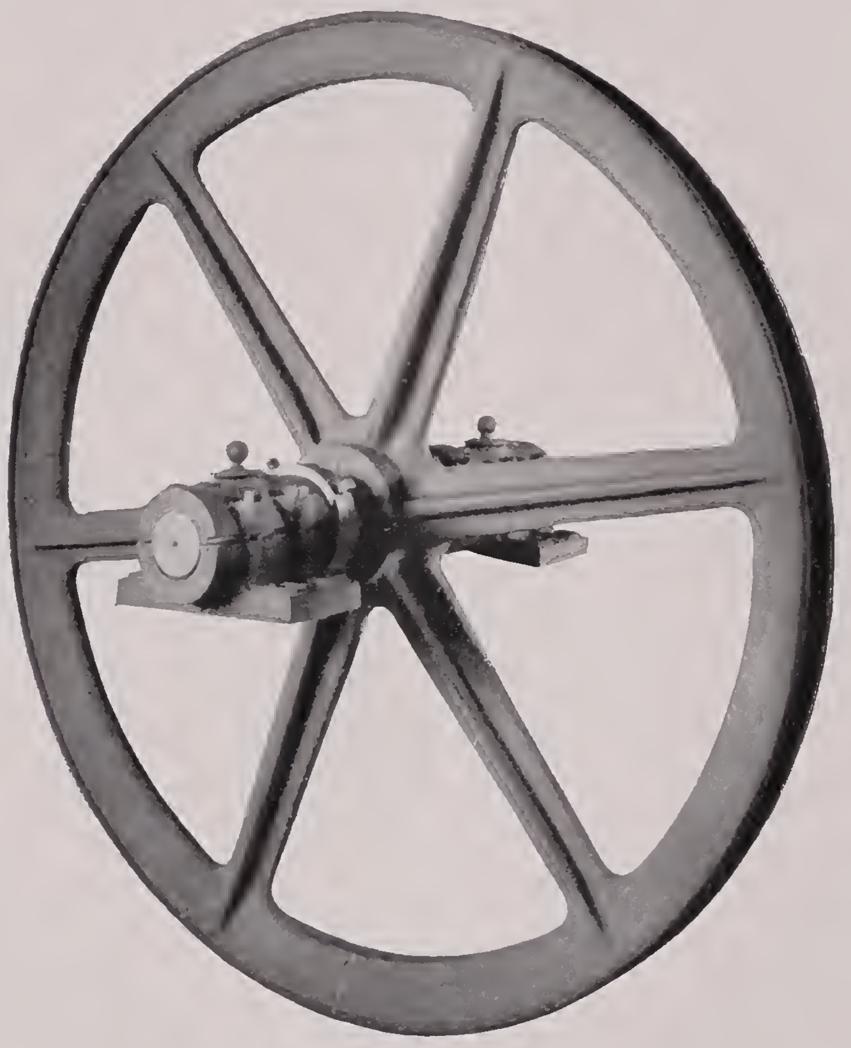
Capacity (Cubic Feet)	Car No.	Dimensions of Body			Weight (Pounds)
		Length (Inches)	Width (Inches)	Depth (Inches)	
8	200	36	24	16	600
10	201	36	24	20	680
12	202	42	24	21	720
14	203	42	24	24	770
16	204	48	24	24	800
18	205	48	30	22	820
20	206	48	30	24	840
22	207	54	30	22	860
24	208	54	30	26	900
26	209	54	32	26	950
28	210	60	34	24	1000
30	211	60	34	26	1050

SHEAVE WHEELS.

Plate 1088 represents our Standard Sheave Wheel with shaft and boxes complete, designed for mining and all other purposes where it is desired to lead wire rope over a sheave with the minimum of friction and wear. The sheave itself is a substantial casting with deep flanges turned out true and smooth to receive the rope.

The shaft is of the best grade of mild steel, and of ample strength for all ordinary hoisting purposes. The boxes are lined with the best quality of anti-friction metal, and

Plate No. 1088.



Sheave Wheel, with Shaft and Boxes.

SHEAVES FOR ROUND ROPE.

Diameter	Size Rope	Weight Sheave only	Weight with Shaft and Boxes
18 inches	⅜ to ½ in.	86 lbs.	120 lbs.
24 "	½ " ⅝ "	115 "	190 "
30 "	⅝ "	165 "	315 "
36 "	¾ "	250 "	430 "
42 "	¾ "	440 "	665 "
48 "	¾ to ⅞ "	460 "	750 "
60 "	⅞ " 1 "	900 "	1200 "
66 "	1 "	1100 "	1400 "
72 "	1 to 1⅛ "	1200 "	1800 "
84 "	1⅛ "	1530 "	2400 "
96 "	1⅛ to 1¼ "	1950 "	3030 "

have adjustable caps for taking up the wear. The caps are provided with oil or tallow cups

The sheaves are fastened to the shaft either by a key or set screw. Special designs of sheaves, with wood, hemp or rubber lined grooves, are made to order and provided with various styles of boxes or pedestals. To meet exceptionally trying conditions, we build sheaves with wrought iron arms, as shown below. Our standard sheaves are of ample strength to carry the load for which the equivalent size of rope given in the table on the next page is suitable.

Plate No 1269.

SPECIAL HEAVY SHEAVES.

The above cut illustrates our design of large sheaves for heavy duty, which are generally made with wrought iron spokes cast in. These large sheaves are made in halves with the rim joints bolted together, and the hubs either bolted or held together by means of a wrought iron ring shrunk on.

We are prepared to build sheaves of any size, and will make quotations on receipt of the necessary information.

SHEAVES FOR FLAT ROPE.

Diameter.	Size Rope.	Weight, Sheave Only.	Weight, with Shaft and Boxes.
36 in.	3 × ⅜ in.	450 lbs.	600 lbs.
48 "	3½ × ⅜ "	750 "	1,000 "
60 "	4 × ⅜ "	1,300 "	1,800 "
72 "	4½ × ⅜ "	1,925 "	2,800 "
84 "	5 × ⅜ or ½	2,200 "	3,260 "
96 "	5½ × ½ in.	2,400 "	3,400 "

HOISTING HOOKS.

SNAP HOOK—This is a hook of the simplest form, with a steel snap spring which effectually prevents the bucket bail from escaping.

SERPENTINE HOOK—This hook is sometimes used when frequent removing of the bucket is required, necessitating a ring or two on the bucket bail for convenience. It gives comparative safety by its form.

CHAIN HOOK—A hook of simple construction for use with buckets for small hoists. This hook and chain serves every purpose of strength and safety as well as convenience, and we recommend it for light loads.

SAFETY DETACHING HOOKS—These hooks are designed to prevent accidents which might be caused by the overwinding of the hoisting rope. When safety hooks are not provided it is possible that through the carelessness of an engineer or because of some derangement of the engine that a cage might be drawn up to the head sheave by the overwinding of the rope and the rope or head sheave or both be broken by the strain. The Allis-Chalmers Company supplies safety detaching hooks of the best designs which make such accidents impossible. Their action frees the hoisting rope instantly whenever the cage happens to be carried beyond its proper position and into contact with a safety stop.

EFFECTIVE WEIGHT OF A LOAD.

The table on the following page will be found useful where hoisting is done on inclined shafts. It may also be applied to "gravity tramways" or "inclined planes."

The following examples will show its uses:

Suppose the weight of ore is 10,000 lbs.; skip, 6,000 lbs.; rope, 7,500 lbs., and that the shaft has an inclination of 55 degrees from the horizontal. What is the strain of the rope? Total load, $10{,}000 + 6{,}000 + 7{,}500 = 23{,}500$.

RULE: For each pound of weight, the effective load on the rope for the angle of incline from the horizontal given in column I will be found opposite in column II. Therefore, find 55 degrees in column I and opposite in column II is .819, which, multiplied by $23{,}500 = 19{,}246.5$ lbs., the total *effective* strain *on rope*.

Suppose an engine can raise 5,000 lbs. in a vertical shaft, what can it pull up an incline 30 degrees from the horizontal?

RULE: For each pound which an engine can lift vertically, it can raise the amount given in column III up an incline of the angle given in column I. Therefore, find 30 degrees

in column I, and opposite in column III is 2, which multiplied by 5,000 = 10,000 lbs., the amount engine can pull up a 30 degree incline.

If the proper working strain of the rope were 5,000 lbs. on a vertical lift, it would be 10,000 lbs. on a 30 degree incline; the process is the same.

NOTE:—In using the table, it must not be overlooked that the friction of drawing the car, skip or cage on the rails or guides is to be added to the effective weight in order to obtain the total amount of strain borne by the rope. This friction is termed "traction" or "tractile effort" and varies between thirty and one hundred pounds per ton, according to circumstances, and is of more importance on inclines of small angle.

TABLE FOR COMPUTING EFFECTIVE WEIGHT OF A LOAD.

I Degree	II Sine	III Cosecant	I Degree	II Sine	III Cosecant
90	1.000	1.000	45	.707	1.414
89	1.000	1.000	44	.695	1.440
88	.999	1.001	43	.682	1.466
87	.999	1.001	42	.669	1.494
86	.998	1.002	41	.656	1.524
85	.996	1.004	40	.643	1.556
84	.995	1.006	39	.629	1.589
83	.993	1.008	38	.616	1.624
82	.990	1.010	37	.602	1.662
81	.988	1.012	36	.588	1.701
80	.985	1.015	35	.574	1.743
79	.982	1.019	34	.559	1.788
78	.978	1.022	33	.545	1.836
77	.974	1.026	32	.530	1.887
76	.970	1.031	31	.515	1.942
75	.966	1.035	30	.500	2.000
74	.961	1.040	29	.485	2.063
73	.956	1.046	28	.469	2.130
72	.951	1.051	27	.454	2.203
71	.946	1.058	26	.438	2.281
70	.940	1 064	25	.423	2.366
69	.934	1.071	24	.407	2.459
68	.927	1.079	23	.391	2.559
67	.921	1.086	22	.375	2.669
66	.914	1.095	21	.358	2.790
65	.906	1.103	20	.342	2.924
64	.899	1.113	19	.326	3.071
63	.891	1.122	18	.309	3.236
62	.883	1.133	17	.292	3.420
61	.875	1.143	16	.276	3.628
60	.866	1.155	15	.259	3.864
59	.857	1.167	14	.242	4.134
58	.848	1.179	13	.225	4.445
57	.839	1.192	12	.208	4.810
56	.829	1.206	11	.191	5.241
55	.819	1.221	10	.174	5.759
54	.809	1.236	9	.156	6.392
53	.799	1.252	8	.139	7.185
52	.788	1.269	7	122	8.206
51	.777	1.287	6	.105	9.567
50	.766	1.305	5	.087	11.474
49	.755	1.325	4	.070	14.336
48	.743	1.346	3	.052	19.107
47	.731	1.367	2	.035	28.654
46	.719	1.390	1	.017	57.299

Column II is the trigonometric sine of angle given in Column I.
Column III is the trigonometric cosecant of angle given in Column I.

PROPER WORKING LOAD FOR STEEL WIRE ROPE.

Certain empirical rules have been in vogue for the determination of the proper working load for wire rope. These were the results of attempted generalizations based on limited experience. Scientific study has shown that such rules are not reliable, especially with reference to minimum diameters of sheaves.

Below is given a thorough method of properly adapting steel ropes to the work required of them, especial attention being given to the importance of the bending strain in determining the proper working load of the rope.

The steel used for the wire rope referred to in the diagram is usually called crucible cast steel and is assumed to have an average ultimate tensile strength of 85 gross tons, or 190,000 pounds per square inch; 50,000 pounds is assumed as the proper working strain in the material, this strain being made up of the load itself, and that due to the bending of the wires over the drum. There are other grades of steel, known as "extra strong crucible cast steel" and "plow steel." Their qualities are different from the grade used in the table, and, when they are desired, should be specially calculated for. In a general way the bending strain is expressed by the formula:

$$S = \frac{\frac{E}{2} \times a}{R}$$, in which formula:

S=strain per square inch due to bending.

E=modulus of elasticity which for crucible cast steel is approximately 29,400,000.

a=diameter of each individual wire.

R=radius of drum upon which rope is wound.

By making the proper divisions the formula is simplified to

$$S = \frac{14,700,000 \times a}{R}$$

For ropes of 19 wires to the strand the diameter of each individual wire is almost exactly 1/15 part of the diameter of the rope, and the formula given for strain in the diagram has been transformed to suit the diameter of the rope itself as well as the *diameter* of the drum instead of the *radius* of the drum, because it was thought that the formula so expressed was much more convenient for use.

The load which wire rope can carry when wound over different drums has been figured in the following manner. If the drum is infinitely large, the load would be equal to 50,000 pounds × the actual cross-section of steel in the rope. Suppose, now, for example, that the strain produced by bending would amount to 20,000 pounds, then the remaining strength, which would be useful in carrying the load, would be only 30,000 pounds, and by figuring in this way for different diameters of drums and ropes, the lines are found as shown on the diagram. The formula for load (L), given on the diagram, is worked out on this basis, and from this it will be seen that the loads given at the extreme right on the diagram are not at all the maximum loads the rope will carry, but are simply the loads which they will carry when used on 20 foot drums. Larger drums are, of course, seldom used, and it is an easy matter to figure out the proper working load for extreme cases.

As to the actual factor of safety it will be seen from the foregoing that it is equal to $^{190000}/_{50000}$ or 3 8/10.

This co-efficient may appear somewhat small, because we are used to speak of factors of safety of six or larger. This is, however, only because of ignorance of the actual conditions. As a matter of fact we have been working with much lower factors of safety. It is well known that ropes often carry much higher loads than those shown on the diagram, in which case they, of course, are strained more than 50,000 pounds per square inch, when the strain due to bending is taken into consideration, which is just as actual as the strain due to the load. In fact it is more so, because there is not always a full load on the rope every time it is hoisted, but there is the full bending strain. The loads shown on the diagram agree very closely with those used in the best mining practice.

STANDARD WIRE HOISTING ROPE.

This rope is usually made with a hemp center, which adds to the pliability and diminishes internal friction in bending. With a wire center the weight is about ten per cent more than with hemp.

The choice of rope depends upon three main points: (1) load; (2) smallest diameter over which used; (3) liability to external wear. As the question involves so many points when the material, number of wires and diameter of rope are to be decided upon, a general statement cannot be made to cover all the principles. Those ropes made of softer materials are more pliable, but have less total strength and wear more quickly. Those of harder materials are stiff, but suffer less from surface abrasion.

The rope generally used for hoisting is called crucible cast steel rope, except for great depths, in which cases plough steel rope is used.

The materials as arranged in the table of sizes, given below, are in the order of their hardness. Their stiffness and ultimate tensile strength are shown in the same order.

Trade Number	Approximate Circumference in Inches	Diameter in Inches	Weight per Foot in Pounds
00	8⅝	2¾	12.00
0	7⅞	2½	10.00
1	7⅛	2¼	8.00
2	6¼	2	6.30
3	5½	1¾	5.25
4	5	1⅝	4.10
5	4¾	1½	3.65
5½	4¼	1⅜	3.00
6	4	1¼	2 45
7	3½	1⅛	2.00
8	3	1	1 58
9	2¾	⅞	1.20
10	2¼	¾	0.88
10¼	2	⅝	0.60
10½	1¾	9/16	0.48
10¾	1½	½	0.39
10a	1¼	7/16	0.29
10b	1⅛	⅜	0.23
10c	1	5/16	0.15
10d	¾	¼	0.10

Made of Swedish Iron, Crucible Cast Steel, or Plough Steel, having six strands of nineteen wires each, with hemp center.

Diagram showing net strength of round rope is given on page 72.

FLAT WIRE ROPE.

Flat wire rope is composed of several round ropes, whose diameter is equal to the thickness of the flat rope required laid side by side and sewed together with iron or annealed cast steel wire. The ropes composing it are alternately of right-hand and left-hand twist, and have four strands, being without either a hemp or wire center. This peculiarity in their manufacture is rendered necessary in order to permit the insertion of the sewing wire and to make the rope more compact. The number of wires composing each strand is generally seven, or, if especially ordered, nineteen or a combination of large and small wires.

In determining the proper size of flat rope to do certain work, the formula herein given for round rope must be used to ascertain strains due to the bending of the wires. In applying this formula, it must be remembered that in flat rope the actual diameter of the wires is greater than that of the wires in round hoisting rope of the same diameter, this being due to the flat rope being made with fewer wires to the strand. The reel center is the smallest diameter over which the rope is bent and this should be the radius used in the formula.

While makers of rope usually state that flat rope has the same breaking strain as round rope of same weight and material, this is strictly true only when the diameter of the wires composing both ropes is the same.

TABLE OF STANDARD SIZES OF FLAT WIRE ROPE.

Width	Thickness	Weight, lbs. per Ft	Width	Thickness	Weight, lbs. per Ft.
7	½	5.82	6	⅜	3 90
6	½	4.92	5½	⅜	3.57
5½	½	4.47	5	⅜	3.25
5	½	4.02	4¼	⅜	2.92
4	½	3.67	4	⅜	2.60
3½	½	3.22	3½	⅜	2.30
3	½	2.32	3	⅜	2.00
....	....	....	2½	⅜	1.69
....	....	....	2	⅜	1.37

The wire in ½ in. rope is approximately .0625 in diameter, and "⅜" rope .05375.

The chief drawbacks to the use of flat rope are first cost and the rapid wear of the sewing wires.

Diagram giving net strength of flat ropes over reels of different diameters is shown on page 73.

Plate No. 645.

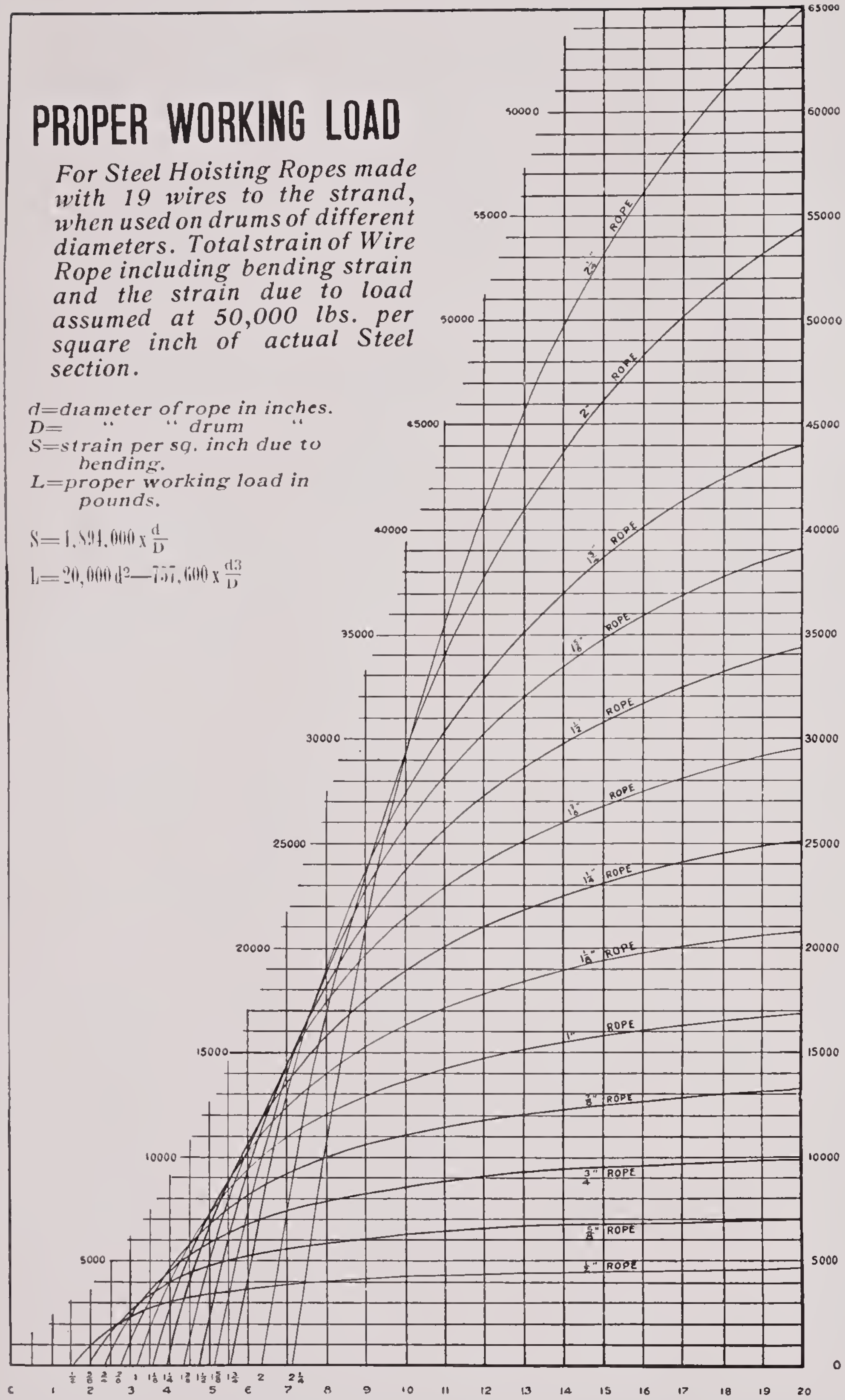

PROPER WORKING LOAD
For Steel Hoisting Ropes made with 19 wires to the strand, when used on drums of different diameters. Total strain of Wire Rope including bending strain and the strain due to load assumed at 50,000 lbs. per square inch of actual Steel section.
d=diameter of rope in inches.
D= " " drum "
S=strain per sq. inch due to bending.
L=proper working load in pounds.
S=1,894,000 x d/D
L=20,000 d²—757,600 x d3/D
ROPE
0
5000
10000
15000
20000
25000
30000
35000
40000
45000
50000
55000
60000
65000

Plate No. 1258.

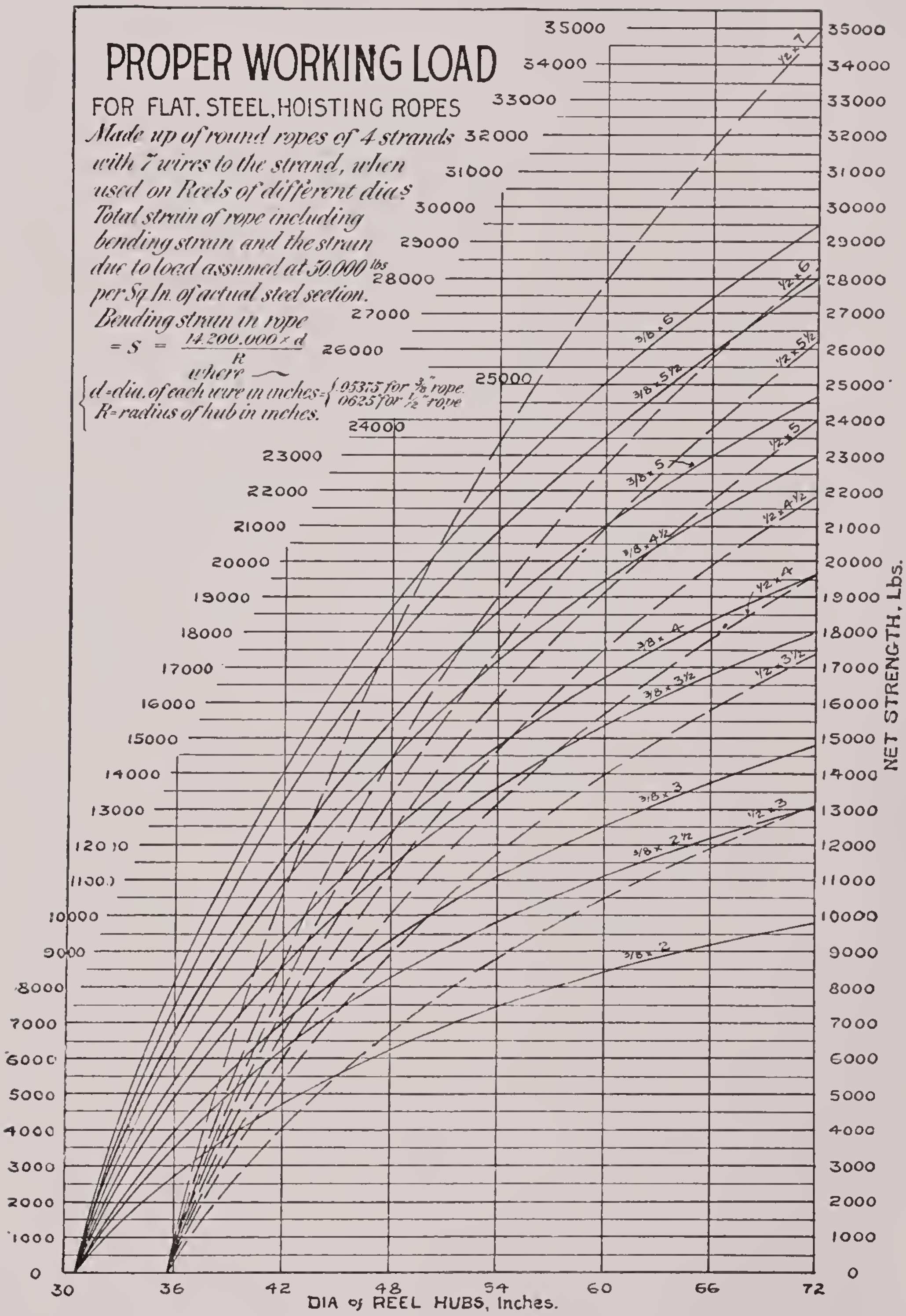
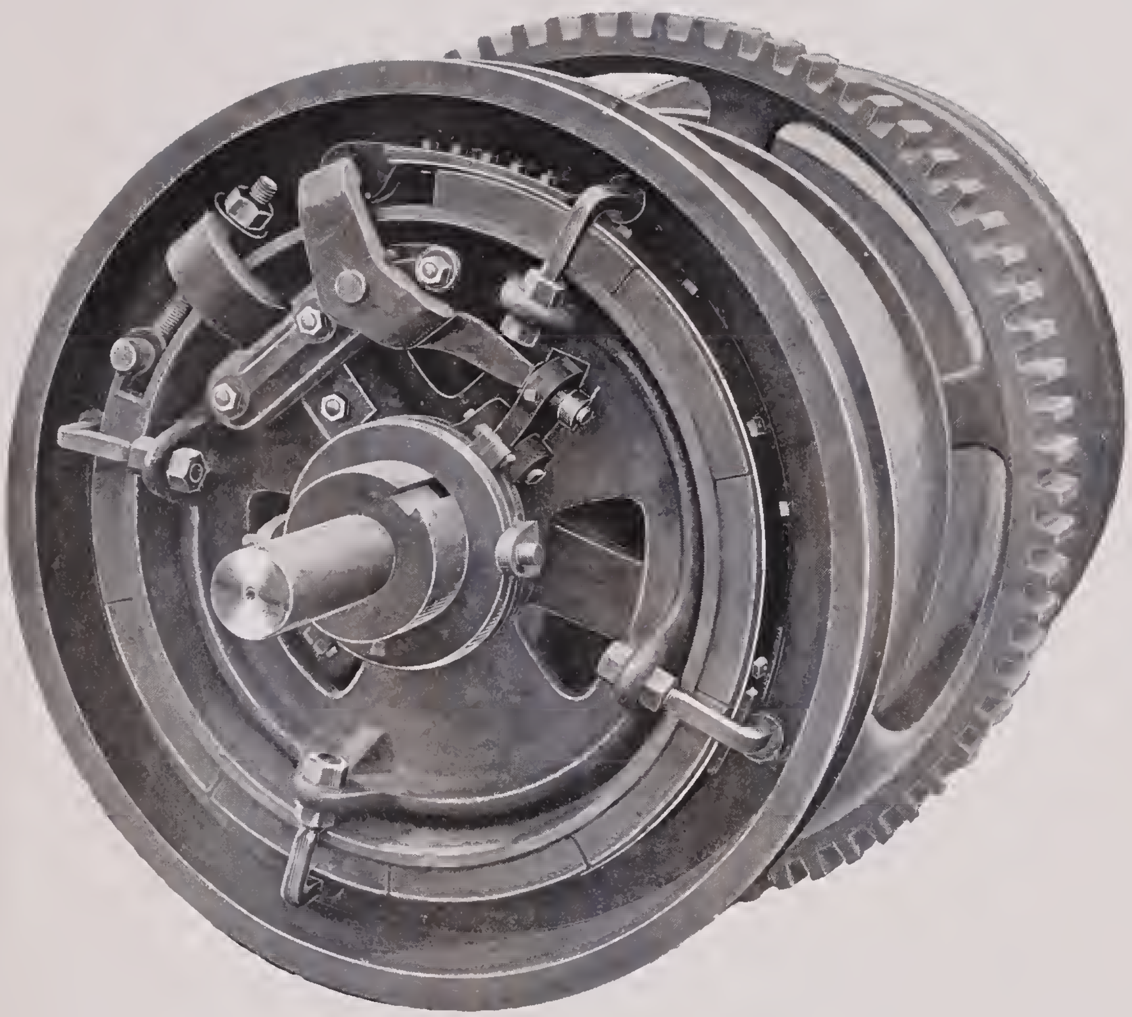


Plate No. 741

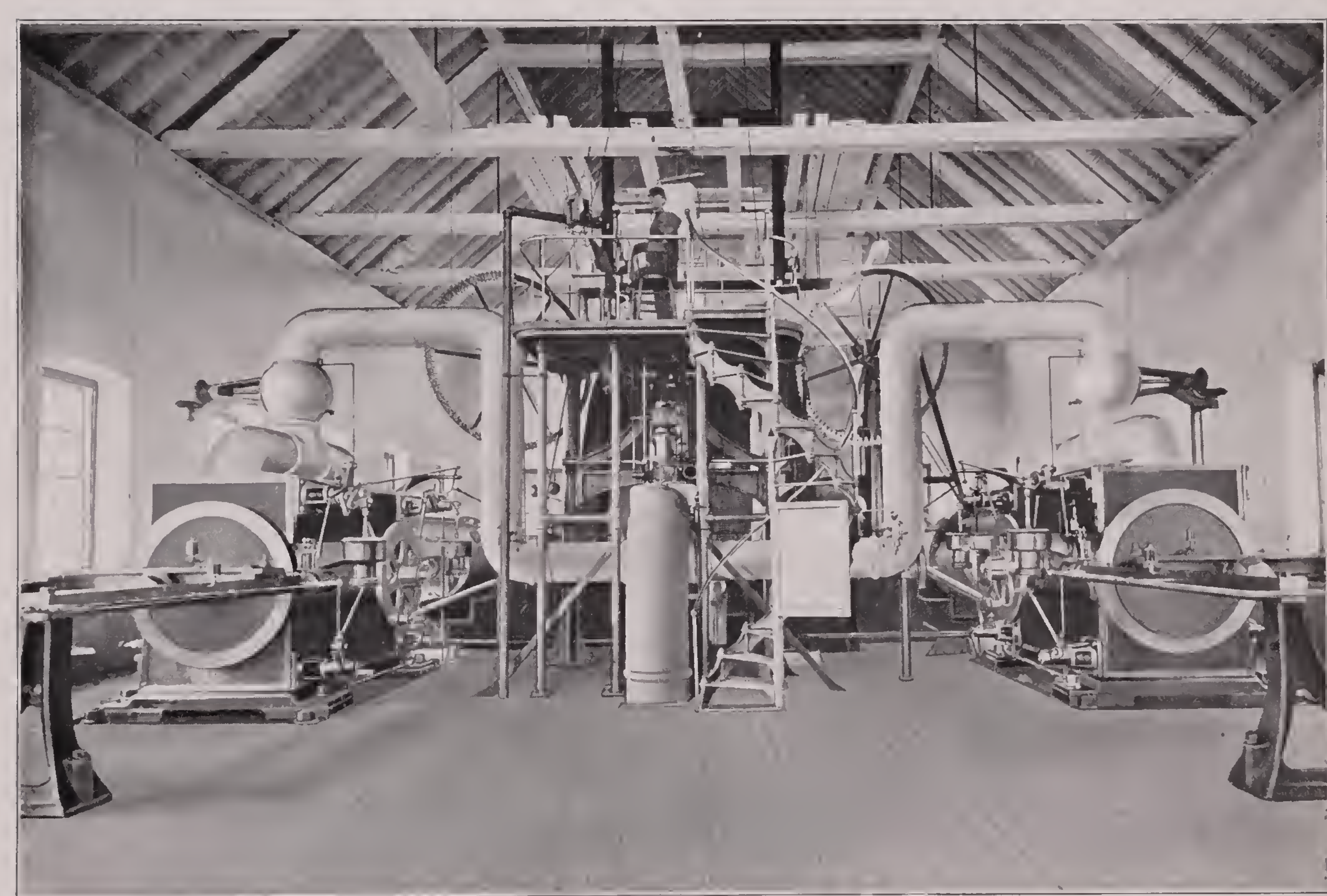


FRICTION BAND CLUTCH.

The clutch shown in Plate 741 is our standard band friction clutch and is a most simple, durable and effective device for driving hoisting drums. The collar, when moved towards the drum, operates a toggle. The motion is transmitted through a steel lever and a powerful pull is given to the friction band, tightening it around the clutch ring.

The band is lined with wooden segments, which can be easily replaced when worn out.

Plate No. 2095.



Hoist at Quincy Mine, Shaft No. 7, Hancock, Mich.

Allis-Chalmers Company

PRINCIPAL PRODUCTS

AIR COMPRESSORS
- Steam Driven
- Belt Driven
- Electrically Driven
- Hydraulic Driven

BLOWING ENGINES

CEMENT MACHINERY
- Ball Mills
- Balls, Forged
- Coal Pulverizing Machinery
- Crushing Rolls
- Elevators
- Mixing Pans
- Perforated Metals
- Revolving Screens
- Rock and Ore Breakers
- Rotary Dryers
- Rotary Kilns
- Tube Mills
- Tube Mill Linings
- Tube Mill Pebbles

CHILLED ROLLS

COAL MINING MACHINERY
- Barney Cars
- Crusher Rolls
- Hoisting Cages
- Revolving Screens
- Shaking Screens
- Ventilating Fans

CONDENSERS
- Jet
- Barometric

CORLISS ENGINES

CRUSHING MACHINERY
- Ballast Plants
- Crushing Rolls
- Dumping Skips
- Gyratory Rock Breakers
- Jaw Crushers
- Macadam Plants
- Perforated Metals
- Portable Crushing Plants
- Revolving Screens
- Quarry Cars
- Elevators
- Hoists

DREDGES
- Gold Dredges
- Dipper Dredges
- Hydraulic Dredges

ENGINES
- Blowing Engines
- Corliss Engines
- Gas Engines
- Hoisting Engines
- Pumping Engines
- Rocking Valve Engines
- Rolling Mill Engines

FEED WATER HEATERS

FLOUR MILL MACHINERY
- Bolters, Universal
- Bolting Cloth
- Bran and Shorts Brushes
- Centrifugal Reels
- Corn Mills
- Feed Mills
- Feed Screens
- Flaking Rolls
- Flour Packers
- Hexagon Reels
- Purifiers
- Roll Corrugating
- Roller Mills
- Rolling Screens
- Scalping Reels
- Sieve Scalpers

GAS ENGINES

HOISTING ENGINES

HYDRAULIC MACHINERY
- Water Turbines
- Turbine Governors

MINING MACHINERY
- Air Compressors
- Boiling Tanks
- Chilian Mills
- Chlorination Plants
- Concentrating Plants
- Copper Converting Plants
- Crushing Plants
- Cyanide Plants
- Frue Vanners
- Gold and Silver Mills
- Gold Dredging Machinery
- Gyratory Breakers
- Hancock Jigs
- Hoisting Machinery
- Horse Whims
- Huntington Mills
- Jaw Crushers
- Lead Refining Plants
- Lixiviation Plants
- Mining Cages
- Mining Cars
- Mine Ventilating Machinery
- Ore Buckets
- Ore Cars
- Ore Feeders
- Overstrom Concentrators
- Prospecting Mills
- Roasting Furnaces
- Skips
- Smelting Machinery
- Stamps, Gravity
- Stamps, Steam
- Stamps, Atmospheric
- Stamp Shoes, and Dies
- Tramways
- Tube Mills, Wet and Dry

PERFORATED METALS

POWER TRANSMISSION MACHINERY
- Belt Tighteners
- Boxes
- Couplings
- Gears
- Hangers
- Pulleys
- Rope Sheaves
- Shafting

PUMPING MACHINERY
- Centrifugal Pumps
- Elevator Pumps
- Fire Service Pumps
- Geared Pumps
- "High Duty" Pumping Engines
- Hydraulic Transmission Pumps
- Mine Pumps
- Multi-Stage, High Lift Centrifugals
- Screw Pumps

ROLLING MILL ENGINES

SUGAR MACHINERY

SAW MILL MACHINERY
- Band Mills, Double Cutting
- Band Mills, Single Cutting
- Band Re-saws, Horizontal
- Board Lifters, Steam
- Cant Flippers, Steam
- Canting Machines, Overhead
- Circular Saw Mills
- Conveying Machinery
- Cutting Off Saws, Steam Feed
- Edgers
- Edging Grinders
- Feeds, Steam, Direct Acting
- Feeds, Steam, Twin Engine
- Filing Room Tools
- Lath Mills and Bolters
- Live Rolls and Drives
- Log Chains
- Log Jacks
- Log Loaders
- Log Turners
- Niggers, Steam
- Rocking Valve Engines
- Saw Mill Carriages
- Set Works
- Slashers
- Steam Feed Valves
- Stock Lifters, Steam
- Trimmers

STEAM SHOVELS

TIMBER PRESERVING MACHINERY

TURBINES—STEAM

TURBINES—WATER

ELECTRICAL DEPARTMENT

The Bullock Electric Mfg. Co.

Alternating Current Generators and Motors.

- Belted type generators
- Engine type generators
- Fly-wheel type generators
- Water-wheel type generators
- Synchronous Frequency Changers
- Induction Motor Frequency Changers
- Synchronous Motor-Generator Sets
- Induction Motor-Generator Sets
- Synchronous Motors
- Induction Motors
- Transformers
- Rotary Converters
- Turbo-Generators

Direct Current Generators and Motors.

- Belted type motors and generators
- Engine type generators
- Railway generators
- Small multipolar motors and generators
- Small Bipolar and multipolar motors and generators
- Street Car Equipments, Motors, Controllers, Etc.
- Complete Bullock Teaser Equipments for Printing Presses
- Multiple Voltage Balancing Sets
- Multiple Voltage Variable Speed Equipments

Switchboards for Direct Current and Alternating Current.

Allis-Chalmers Company

General Offices - - Milwaukee, Wis.

WORKS

Milwaukee:

Reliance Works:

Flour Mill and Saw Mill Machinery,
Power Transmission Machinery.

West Allis Works:

Steam Engines, Hoisting Engines, Blowing Engines,
Pumping Engines, Steam and Hydraulic Turbines.

Chicago:

Works No. 1:

Crushing and Cement Machinery.

Works No. 2:

Mining Machinery.

Scranton, Pa.:

Scranton Works:

Sugar Machinery.

Cincinnati, Ohio: Electrical Department, The Bullock Electric Mfg. Co.

Executive Offices - - - - - 71 Broadway, New York, N. Y.

DISTRICT OFFICES

Atlanta, Ga., Fourth Nat'l Bank Bldg.
Baltimore, Md., Continental Bldg.
Boston, Mass., State Mutual Bldg.
Buffalo, N. Y., Ellicott Square Bldg.
Butte, Mont., 51 East Broadway
Chicago, Ill., First National Bank Bldg.,
Cincinnati, O., First National Bank Bldg.
Cleveland, Ohio, New England Bldg.
Dallas, Texas, Wilson Bldg.
Deadwood, S. D.
Denver, Col., 1651 Tremont St.
Detroit, Mich., 800 Union Trust Bldg.
El Paso, Texas, Orndorff Hotel Bldg.
Kansas City, Mo., The Dwight Bldg., cor. Baltimore Ave. and Tenth St.
Minneapolis, Minn., Corn Exchange Bldg.
New York, 71 Broadway.
Omaha, Neb., 502 N. 25th St.
Philadelphia, Pa., Land Title Bldg.
Pittsburg, Pa., Frick Bldg.
St. Louis, Mo., Chemical Building.
Salt Lake City, Utah, 209 S. W. Temple St.
San Francisco, Cal., Rialto Building.
Seattle, Wash., 316 Occidental Ave.
Spokane, Wash. cor. Howard and First Sts.

FOREIGN SALES OFFICES

London, 533 Salisbury House, Finsbury Circus, E. C.
Johannesburg, South Africa, The Corner House.

CANADA

Allis-Chalmers-Bullock, Ltd.: Works, Montreal, Canada.

Offices

Halifax, N. S.—Allis-Chalmers-Bullock, Ltd., 146 Hollis St.
Montreal, Canada—Allis-Chalmers-Bullock, Ltd., Sovereign Bank Bldg.
Toronto, Canada—Allis-Chalmers-Bullock, Ltd., McKinnon Bldg.
Vancouver, B. C.—Allis-Chalmers-Bullock, Ltd., Ormidale Bldg.
Winnipeg, Manitoba—Allis-Chalmers-Bullock, Ltd., Canada Life Bldg.

FOREIGN SALES AGENCIES

Auckland, New Zealand,	John Chambers & Son, Ltd.
Buenos Ayres,	Donnell & Palmer
Constantinople, Turkey,	J. G. Johnson & Co.
Johannesburg, South Africa,	Herbert Ainsworth (for Rock Crushers Only)
Lima, Peru,	Henry Guyer
Melbourne, Australia,	Knox, Schlapp & Co., Propy. Ltd.
Perth, West Australia,	Frank R. Perrot
Valparaiso, Chili,	John R. Beaver
Yokohama, Japan,	The American Trading Company

Allis-Chalmers Company.

DIRECTORS

Edward D. Adams, New York.
Charles Allis, Milwaukee, Wis.
William W. Allis, Milwaukee, Wis.
George Bullock, Cincinnati, O.
William J. Chalmers, Chicago, Ill.
Mark T. Cox, East Orange, N. J.
James H. Eckels, Chicago, Ill.
Elbert H. Gary, New York.
Max Pam, Chicago Ill.
William A. Read, New York.
Edwin Reynolds, Milwaukee, Wis.
James Stillman, New York.
Cornelius Vanderbilt, New York.
Edmund C. Converse, New York.
Benjamin H. Warren, New York.

EXECUTIVE COMMITTEE, NEW YORK OFFICE.

Edward D. Adams, Chairman.

Charles Allis.
Mark T. Cox.
Elbert H. Gary.
William A. Read.
James Stillman.
Cornelius Vanderbilt.

EXECUTIVE OFFICERS OF THE COMPANY.

Chairman of the Board of Directors: Elbert H. Gary, New York.
Chairman of the Executive Committee, Edward D. Adams, New York.
President: Benjamin H. Warren, New York.
Vice-President and General Manager: Walter H. Whiteside, Milwaukee, Wis.
Vice-President and Treasurer: William J. Chalmers, Chicago, Ill
Vice-President and Secretary: W. W. Nichols, New York.
Comptroller: James A. Milne, Milwaukee, Wis.
Assistant Treasurer and Assistant Secretary: Henry Woodland, Milwaukee, Wis.
Assistant Secretary and Ass't Treasurer: George A. Brewster, New York.

Chief Engineer: Asa M. Mattice, Milwaukee, Wis.
Consulting Engineer: Edwin Reynolds, Milwaukee, Wis.
General Superintendent: Charles C. Tyler, Milwaukee, Wis.
Chief Electrical Engineer: B. A. Behrend, Cincinnati, Ohio.
Manager of Publicity: Arthur Warren, Milwaukee, Wis.